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# Ground-Water Resources of the Brunswick Formation in Montgomery and Berks Counties, Pennsylvania.

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# Ground-Water Resources of the Brunswick Formation in Montgomery and Berks Counties, Pennsylvania

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# Ground-water Resources of the Brunswick Formation in Montgomery and Berks Counties, Pennsylvania

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## ABSTRACT

The Brunswick Formation in Montgomery and Berks Counties, Pa., consists of reddish-brown shale, mudstone, and siltstone, which are interbedded with sandstone and fanglomerate near the northern border of the Triassic basin. In places the Brunswick Formation has been intruded by diabase dikes and sills, and throughout much of its outcrop area it is interbedded with the Lockatong Formation. The Lockatong Formation in Montgomery County consists principally of massively bedded medium- to dark-gray argillite interbedded with thin beds of gray to black shale, siltstone, and marlstone.

Ground water in the Brunswick and Lockatong Formations occurs largely in secondary openings such as joint planes. These secondary openings are more abundant and much more closely spaced in the Brunswick Formation than in the Lockatong Formation. Consequently, wells in the Lockatong Formation generally yield water for domestic purposes only whereas many wells in the Brunswick Formation yield sufficient water for industrial and municipal use.

Data from 199 wells that obtain water from only the Brunswick Formation in Montgomery County indicate that wells should be drilled at least 200 feet deep, if yields of more than 100 gpm (gallons per minute) are desired. Wells drilled to depths between 200 and 550 feet are most likely to obtain maximum yields.

Pumping tests in the Brunswick Formation, using observation wells, were made at six localities. Coefficients of transmissibility computed from drawdown data at the observation wells are much higher than transmissibilities calculated at the pumped wells, demonstrating the poor hydraulic connection between the pumped wells and the observation wells. The excessively high transmissibilities are useful for estimating the effect of pumping upon nearby wells and indicate that interference between wells during brief periods of pumping may be somewhat less in the Brunswick Formation than in an ideal aquifer. Water levels in the observation wells declined to a greater extent than predicted by the transmissibilities computed from data obtained during the early part of a pumping test, however, because impermeable boundaries appear in the test data of almost all observation wells. Transmissibilities computed for the pumped wells at the six test localities range from 100 to 5,000 gpd (gallons per day) per foot, and the median transmissibility is 1,100 gpd per foot.

Transmissibilities determined from additional pumping tests in the Brunswick Formation, which were made without observation wells, range from 140 to 4,000 gpd per foot, and the median is 600 gpd per foot. Transmissibilities determined from pumping tests in the Lockatong Formation, all of which were made without observation wells, range from 60 to 2,600 gpd per foot, and the median is 150 gpd per foot.

Observation wells situated along a line from the pumping well that is perpendicular to the strike of the beds show much less drawdown in response to pumping than do wells situated along a line parallel to the strike, because the former do not penetrate the same strata as the pumped well. The resultant cone of depression surrounding a pumping well is ellipsoidal in shape—being elongated parallel to strike.

Chemical analyses of ground-water are available from 36 wells in the Brunswick Formation and six wells in the Lockatong Formation. Ground water in both formations is largely of the calcium-bicarbonate type. However, water samples from the Brunswick Formation having concentrations of dissolved solids greater than 500 ppm (parts per million) are of the calcium-sulfate type. Median dissolved-solids content is 302 ppm in water from the Brunswick Formation and 268 ppm in water from the Lockatong Formation. Median hardness as $CaCO_3$ is 218 ppm in water from the Brunswick Formation and 206 ppm in water from the Lockatong Formation.

# INTRODUCTION

## PURPOSE AND SCOPE

Prior to 1940, the area in Montgomery and Berks Counties that lies to the north and northwest of Philadelphia, Pa., consisted chiefly of small towns surrounded by farm land. The industrialization and urbanization of this area increased rapidly after the Second World War. For example, the population of Montgomery County as determined by the 1940 census was only 289,247, but by 1960 the population had risen to 516,682, almost double the 1940 figure. Most of the population increase and industrial investment occurred in the southern part of Montgomery County while the northern part retained its rural character.

The development of new ground-water supplies to meet the increased demands of industries, municipalities, and individual consumers in this rapidly growing area has been seriously handicapped by a lack of geologic and hydrologic data. Having recognized that maximum utilization of the available supply depends on understanding the occurrence, movement, and distribution of the ground water in the area, a study of the occurrence of ground-water in the Triassic rocks of southeastern Pennsylvania was begun in 1956 by the U.S. Geological Survey in cooperation with the Pennsylvania Topographic and Geologic Survey.

This report deals chiefly with the ground-water resources of the Brunswick Formation in Montgomery and Berks Counties, although some attention is directed to the water-bearing properties of the Lockatong Formation in the same area. It is one of a series of reports that will eventually describe the ground-water resources of the rocks of Triassic age in southeastern Pennsylvania. The first of these, a report on the Stockton Formation in southeastern Pennsylvania, was published in 1962 (Rima, D. R., and others, 1962).

## LOCATION OF THE AREA

The area covered by this report is in Montgomery and Berks Counties, in southeastern Pennsylvania, between lat. 40°08′ and 40°27′ N. and long. 75°09′ and 75°56′ W. (See Fig. 1.) The area extends for 41 miles from the eastern border of Montgomery County to its most western point, on

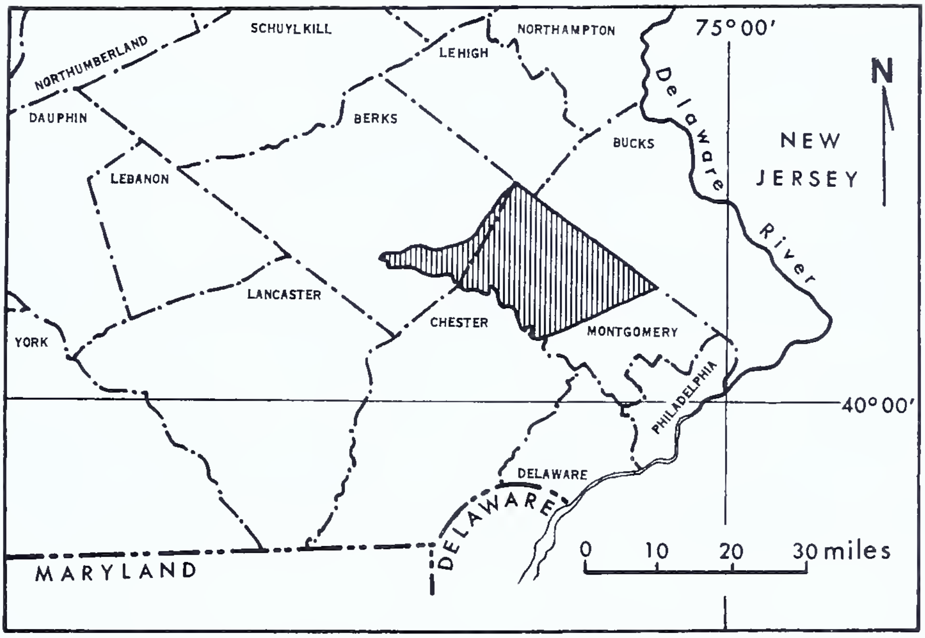



Figure 1. Map of southeastern Pennsylvania showing location of area covered by this report.

the Schuylkill River near Reading, Pa. It is 16 miles wide in eastern Montgomery County and narrows to less than 1 mile wide near Reading. The total area covered by the report is 347 square miles, of which 300 square miles is in Montgomery County and 47 square miles is in Berks County.

## METHODS OF THIS INVESTIGATION

An inventory was made of nearly all municipal and industrial wells and about 70 rural and domestic wells in the area covered by this report. The records for 322 wells are given in table 6, and the well locations are shown in Plate 1.

Pumping tests ranging in duration from 3 to 101 hours (and making use of observation wells) were made at six locations. Short-term pumping tests (generally of 1-hour duration and without the use of observation wells) were made at 15 wells. Three test wells were drilled in order to obtain geologic data and to provide sites for pumping tests.

Ground-water samples were collected from 42 wells, and complete chemical analyses of the samples were made by the Quality of Water Branch, U.S. Geological Survey.

## PREVIOUS INVESTIGATIONS

The ground-water resources of the Brunswick and Lockatong Formations in Berks and Montgomery Counties were described very briefly by Hall (1934) who made a reconnaissance investigation of the ground-water resources of southeastern Pennsylvania. Rima (1955) investigated the ground-water resources of the Brunswick Formation in the vicinity of

Lansdale. Greenman (1955) described the ground-water resources of the Brunswick and Lockatong Formations in adjoining Bucks County. Barksdale and others (1958) prepared a report covering the ground-water resources in the tri-state region adjacent to the lower Delaware River, which discussed the water-bearing properties of the Brunswick and Lockatong Formations.

The geology of the Quakertown and Doylestown 15-minute quadrangle was described and mapped by Bascom and others (1931). Bascom and Stose (1938) described the geology of the Phoenixville 15-minute quadrangle. Since 1932, D. B. McLaughlin has written many articles describing the geology of the Brunswick and Lockatong Formations in southeastern Pennsylvania. These articles are summarized in the report on the geology of the Mesozoic rocks in Bucks County (McLaughlin, 1959) which describes in detail the geology of the Brunswick and Lockatong Formations in southeastern Pennsylvania.

## ACKNOWLEDGMENTS

The writers acknowledge with appreciation the cooperation and assistance received from well drillers, industries, home owners, water companies, and local, state, and federal governmental agencies.

Appreciation is expressed to Leeds and Northrup Co., North Wales, who permitted their wells to be used for water-level measurements, assisted in aquifer tests, and supplied drillers logs of wells. Nice Ball Bearing Co., Kulpsville; Kawecki Chemical Co., Boyertown; Douglassville Development Corp., Douglassville; Pennhurst State School, Spring City; and Charles Johnson County Home, Royersford; permitted their wells to be used in pumping tests and made available sites for additional test wells. Acknowledgment is made to Souderton Borough for providing sites for water-level recorders and permitting the use of their wells in aquifer tests.

Most of the data for the geologic map (Pl. 1) was obtained from unpublished geologic maps by Dr. Dean B. McLaughlin, University of Michigan.

## WELL-NUMBERING SYSTEM

All wells used in this report have an identification number and a location number. The identification number consists of two parts. The first part is a two-letter symbol that identifies the county in which the well is located. For example, wells in Montgomery County are identified by the symbol Mg and those in Berks County are identified by the letters Be. The second part of the identification number is a serial number that was assigned at the time the well was first visited during the field investigation.

Each well identified in the manner described is located by means of a three-part well-location number. The first two parts are obtained by super-

imposing a grid network on the area of investigation. The network is constructed of 1-minute parallels of latitude and meridians of longitude. Thus, it consists of a series of 1-minute quadrangles each of which can be identified by two three-digit numbers. The first number, which identifies the latitude bounding the quadrangle on the south, is formed by the last digit used in the number of degrees latitude and the two digits used in the number of minutes. The second three-digit number is obtained in a similar way by using the degrees and minutes of the longitude bordering the quadrangle on the east. The third part is a serial number assigned to distinguish the wells from others in the same quadrangle.

For example, a well in Montgomery County given identification number Mg-633 bears the location number 015-520-10. This well is located in the 1-minute quadrangle that is bounded on the south by latitude 40°15′ and on the east by longitude 75°20′. The serial number 10 indicates that this well was the tenth well visited within that 1-minute quadrangle.

## CLIMATE

Pennsylvania has a humid climate and moderate temperatures. Most of the weather disturbances that affect Pennsylvania are carried from the interior of the continent by prevailing westerly winds. However, coastal storms occasionally affect day-to-day weather in the southeastern part of the state (Kauffman, 1960, p. 2). Differences in elevation within the area in this report are not great enough to cause any major differences in climate.

Temperatures in southeastern Pennsylvania generally range from 0°F to 100°F. The summers are long, and daily temperatures reach 90°F or above on an average of 25 days during the summer. The winters are mild, and the minimum temperatures go below 32°F an average of less than 100 days a year. The average annual temperature for the report area, based on data for Phoenixville, is 54.3°F. Mean monthly temperatures at Phoenixville range from 33.1°F in February to 76.7°F in July. (Data from U.S. Weather Bureau climatic summaries.) The freeze-free season usually ranges from 170 to 200 days.

The average annual precipitation from 1931 to 1955, based on records from several stations within the area, was about 44 inches. The minimum annual precipitation recorded within the report area is 26.45 inches at Pottstown in 1930. The maximum annual precipitation recorded for the area is 71.32 inches at Pottstown in 1889.

Precipitation is fairly well distributed throughout the year, but occasionally dry spells persist for several months with very little rainfall. The average seasonal snowfall is about 30 inches; the ground is covered by snow about one-third of the time during the winter.

Occasional severe coastal storms have caused a normal 1-month rainfall to occur within a period of 48 hours. Floods have been caused by these

coastal storms and by melting snow and heavy rain in the spring. Major flooding occurred along the Schuylkill River in 1902, 1935, 1942, and 1955.

## GEOLOGY

### NEWARK GROUP

Rocks of Triassic age occupy a series of disconnected, downfaulted basins that extend from Nova Scotia to North Carolina. These rocks, known as the Newark Group, often have a reddish color and consist principally of conglomerate, arkose, sandstone, siltstone, argillite, and shale. They are interbedded with basaltic lava flows and are intruded by diabase dikes and sills.

McLaughlin (1957, p. 1492-1493) believes that the Newark Group is of Late Triassic age. Paleontologic data support this conclusion (Wherry, 1959, p. 124). Rocks of the group overlie Paleozoic and Precambrian rocks unconformably, and in New Jersey the Newark Group is overlain unconformably by Cretaceous rocks.

The Triassic rocks of Montgomery and Berks Counties are part of the largest Triassic basin in the eastern United States. This basin extends from the Hudson River in southeastern New York, across New Jersey, southeastern Pennsylvania, Maryland, and into northern Virginia. In Pennsylvania the width of the basin ranges from about 30 miles in eastern Montgomery County to about 4 miles southeast of Lebanon, Pa.

In southeastern Pennsylvania and western New Jersey the Newark Group has been divided, proceeding from the oldest sediments to the youngest, into the Stockton, Lockatong, and Brunswick Formations. (See Pl. 1.) These formations were described at the type locality in New Jersey by Kummel (1897). The Stockton Formation is composed of interbedded arkosic sandstone and conglomerate, red shale, and red siltstone. The Stockton is overlain to the north by the Lockatong Formation, which is made up principally of dark gray argillite. The Lockatong is overlain to the north by the Brunswick Formation, which consists chiefly of red shale and siltstone although there is some interbedded sandstone and conglomerate near the north border of the outcrop. The Brunswick Formation is equivalent to the Gettysburg Shale in Adams, York, and Lancaster Counties, Pa., the two formations having been deposited almost contemporaneously.

Although the sum of the thicknesses of the individual formations in the Newark Group is about 18,000 feet, the total thickness of the Newark Group present at any one place in southeastern Pennsylvania probably does not exceed the 12,000 feet believed to be present at the center of the basin (McLaughlin and Willard, 1949, p. 43). The absence of the total

thickness at any one place is postulated because the floor of the basin probably shelved northward and deposition did not start along the northern edge of the basin until several thousand feet of sediments had accumulated in the central part of the basin. This theory is supported by the fact that the Brunswick Formation was deposited directly upon Paleozoic and Precambrian rocks along part of the northern border of the Triassic basin in Pennsylvania.

## LOCKATONG FORMATION

The Lockatong Formation occurs principally in a single continuous belt along the southern edge of the Brunswick Formation. The width of this belt in Montgomery and Berks Counties varies from 4 miles at the Bucks County-Montgomery County line to 1¼ miles at the Schuylkill River. This main body of Lockatong Formation underlies an area of 46 square miles in Montgomery County. A few relatively thin tongues of Lockatong occur well up-section (northward) in the Brunswick Formation, and although most of these tongues do not extend far to the west of the Bucks County line, some of them can be traced for about 30 miles westward to the Schuylkill River.

The Lockatong Formation in Montgomery County consists principally of medium-to dark-gray argillite interbedded with thin beds of gray to black shale, siltstone, and marlstone. Bedding is principally massive. Van Houten (1960, p. 666) indicates that the Lockatong contains a large percentage of analcime (up to 40 percent) along with dolomite, feldspar, and clay. Quartz is a very minor constituent of the Lockatong Formation. Pyrite is scattered throughout the formation and calcite is common, especially in joints.

In the area of this investigation the Lockatong Formation attains its maximum stratigraphic thickness at the Bucks County line. A stratigraphic section measured by McLaughlin (1959, p. 88) at this locality shows a thickness of slightly over 4,000 feet. The Lockatong Formation thins rapidly to the west and is only about 1,500 feet thick at the Schuylkill River (Bascom and Stose, 1938, p. 72).

The Lockatong Formation overlies the Stockton Formation conformably, and probably there is some interfingering of the two formations (McLaughlin, 1959, p. 77). The Lockatong is overlain conformably by the Brunswick Formation, and there is considerable interfingering between these formations—especially in eastern Montgomery County. Where there is interfingering, the percentage of red beds in the section increases upward in the stratigraphic column until the red beds of the Brunswick Formation predominate over the gray shale and argillite of the Lockatong.

The Lockatong Formation grades westward along strike into the typical red shale, mudstone, and siltstone of the Brunswick Formation. This

gradation and thinning westward continues until the Lockatong Formation disappears a few miles west of Phoenixville.

## BRUNSWICK FORMATION

In Montgomery and Berks Counties, the Brunswick Formation, together with the associated diabase intrusives, occupies an area of 301 square miles. Two large areas of Brunswick, one of about 25 square miles (lying mostly in Upper Hanover Township, Montgomery County) and the other of 50 square miles (lying mostly in Douglass and New Hanover Townships, Montgomery County) are separated from the main body of the Brunswick Formation by diabase intrusives.

The Brunswick Formation consists typically of reddish-brown shale, mudstone, and siltstone. A few very thin beds of green shale and brown shale are present in the Brunswick, and in some places they can be used as marker beds for distances up to 1 mile. Van Houten (1960, p. 669) indicates that the Brunswick Formation consists chiefly of feldspar, illite, chlorite, quartz, and calcite. Some beds are finely micaceous. Joints in the Brunswick Formation commonly are partly filled with calcite and quartz. Occasionally barite and pyrite are present as joint filling, and very small crystals of pyrite may be disseminated throughout the rock.

The total apparent thickness of the Brunswick Formation in Bucks County is about 9,000 feet (McLaughlin, 1959, p. 99). The maximum thickness is greater to the west and is about 16,000 feet near Pottstown, Pa. (Bascom and Stose, 1938, p. 76).

Near the base of the Brunswick much of the rock is tough thick-bedded red argillite and is interbedded with dark-gray argillite of the Lockatong Formation. This red argillite grades upward and also along strike into red shale, mudstone, and siltstone. Near the north border of the Triassic basin, the typical shales, mudstones, and siltstones of the Brunswick Formation are interbedded with and grade laterally into sandstone and fanglomerate.

There are many excellent exposures of the Brunswick Formation—especially along streams and railroad cuts. For detailed geologic sections the reader is referred to McLaughlin (1933) and Bascom and Stose (1938). Table 7 contains seven sample logs that illustrate the relatively uniform character of the Brunswick Formation. Some of them (Be-125 for example) show that beds of gray argillite typical of the Lockatong are present also in the Brunswick Formation.

## FANGLOMERATES

Fanglomerates occupy about 6 square miles along the northern border of the area of investigation. These fanglomerates were deposited as alluvial fans by streams flowing into the basin from the north. They are mostly limestone breccias consisting of angular gray limestone pebbles in a red-

dish-brown or buff, fine-grained, sandy-to-argillaceous matrix. Some pebbles of quartzite and other rocks are also present.

These fanglomerates occur at several locations along the northern border and are extensively interbedded with typical shale and siltstone of the Brunswick. The beds of limestone breccia grade along strike into reddish-brown sandstone and then into reddish-brown shale.

Outcrops of fanglomerate are very scarce in Montgomery County; however, in Berks County the area of fanglomerate that crosses the Schulykill River south of Reading is exposed in many places.

The fanglomerates are some of the youngest beds within the Brunswick Formation. However, west of the Schuylkill River, fanglomerates were deposited throughout most of the period of deposition of the Brunswick Formation. Several tongues of fanglomerate extend eastward towards the Schulykill River, and are represented at the river by a few thin sandstone beds.

The areas mapped as fanglomerate on Plate 1 are areas in which breccia and conglomerate are more prevalent than the interbedded shale, siltstone, and mudstone.

## METAMORPHISM

Near the diabase intrusives the shales of the Brunswick Formation are altered to dark, tough hornfels. These hornfels closely resemble the Lockatong Formation because of the change of color caused by the reduction of ferric to ferrous oxide. The effect of the metamorphism on the color of the sediments is gradational, the first effect being the change from red to purplish red. With increased baking the beds change from purple to dark gray or blue black.

The width of the altered zone differs greatly from place to place. Adjacent to the smaller dikes the zone is usually between 40 and 100 feet wide, and in the vicinity of the larger intrusives the altered zone may be more than 1 mile wide. The rocks near the outer limit of the altered zone show very little change in lithology.

## DIABASE

The Brunswick Formation has been intruded by many diabase dikes and sills in southeastern Pennsylvania. The dikes are generally 5 to 100 feet thick, and their outcrops may extend for several miles. The diabase in these narrow dikes is black, dense, very fine-grained, and consists of 90 to 95 percent labradorite and augite.

The sills, with few exceptions, are much thicker than the dikes. The largest sills in the area are more than 1,000 feet thick. The diabase in the larger intrusives, except in the chilled border zone, is medium to coarse grained, greenish gray, and also consists of 90 to 95 percent labradorite and augite (Ryan, 1959, p. 155).

### STRUCTURE

The average dip of the beds in the Brunswick and Lockatong Formations is to the north and northwest at about 20°. Several broad synclines and anticlines, whose axes trend about N. 60° W., are superimposed on this homocline.

The Brunswick and Lockatong Formations have been cut by many faults, most of which are relatively small. Some of these small faults may be observed in the railroad cut south of North Wales. McLaughlin (1942) gives the location of several faults.

The largest fault observed in Berks and Montgomery Counties passes between Hatfield and Souderton in an east-west direction. It has a throw of about 3,000 feet at the Bucks County-Montgomery County line (McLaughlin, 1959, p. 129). The Brunswick Formation is in fault contact with the underlying Paleozoic and Precambrian rocks along part of the northern border of the Triassic basin.

Joint systems are well developed in many of the beds in the Brunswick Formation. A very small set of joints strikes about N. 30° E., and one or both of two additional, less well-developed sets may be observed at most outcrops. These additional sets strike about N. 45° W. and N. 75° E. All of the joints are nearly vertical, and the average distance between joints in most sets is about 6 inches. The strike of the Joint sets appears to be independent of the dip and strike of the beds.

## HYDROLOGY

### PRINCIPLES

Ground water is the subsurface water in that part of the zone of saturation in which all the interconnected pores, crevices, and voids in the rock are filled with water under pressure equal to or greater than atmospheric. Precipitation is the source of ground water in southeastern Pennsylvania. Although most of the water that reaches the land surface from the atmosphere either runs off as overland flow or is returned to the atmosphere by evaporation and transpiration, some infiltrates downward through the soil to the zone of saturation, where it becomes recharge to the main ground-water body. Upon reaching the zone of saturation, it begins to move downward and laterally toward lower elevations, and eventually it may return to the surface either naturally (through springs) or artificially (through wells). Under natural conditions and over long periods of time, the amount of water that leaves the zone of saturation as discharge is balanced by the amount of water that enters it as recharge.

Ground water may be roughly divided into two classes: (1) that which occurs in the shallow formations, mostly under nonartesian conditions, and (2) that which occurs in the deeper formations, under artesian condi-

tions. Nonartesian conditions are those in which ground water is unconfined, so that its upper surface (the water table) is free to rise and fall. Artesian conditions are those in which the ground water is confined in a permeable formation that is overlain by a relatively impermeable formation, so that the upper surface of the confined water is not free to rise and fall, and the water is under sufficient pressure to rise above the top of the formation that contains it where that formation is penetrated by wells. The imaginary surface to which water will rise in tightly cased wells tapping the artesian aquifer is called the piezometric surface.

In humid areas, such as southeastern Pennsylvania, the water table stands at or near the land surface in valleys and rises toward adjacent topographic divides. The slope of the water table is generally less than that of the land surface; hence, the depth to the water table below the land surface is usually greatest beneath topographic highs and least beneath topographic lows.

The water table does not remain in a fixed position but fluctuates in response to additions to and withdrawals from the zone of saturation. As the seasonal variation in precipitation in southeastern Pennsylvania is small, the dominant factor controlling the fluctuation of the water table in areas remote from pumped wells is the seasonal variation in the rate of evaporation and transpiration. Thus the water table generally declines throughout the warm growing season (April to October) and rises throughout the remainder of the year.

Within the zone of saturation, the rocks of the earth's crust differ greatly in their capacity to store and transmit ground water. Rocks that are capable of yielding usable quantities of ground water to wells are called aquifers. An aquifer may consist of all or part of a geologic formation or group of formations.

Most of ground water, like water in other phases of the hydrologic cycle, is continually in motion. It flows by gravity from intake or recharge areas, where hydraulic potentials are high, through permeable zones or aquifers to points of discharge, where hydraulic potentials are low.

## OCCURRENCE OF GROUND WATER IN THE BRUNSWICK FORMATION

The Brunswick Formation is composed of very fine-grained rocks. The pore spaces within the rock matrix are very small and offer great resistance to the flow of ground water. Therefore, the permeability due to the primary porosity of the Brunswick Formation is small.

Most of the ground-water movement within these rocks follows secondary openings that were developed by external forces, following deposition of the beds. Some of these openings are fractures that parallel the bedding planes. They are usually narrow and probably contribute little to the permeability. The most important openings are nearly vertical joint

planes that cross each other at various angles throughout the beds. These vertical joints provide an interconnected series of channels through which ground water can flow.

The number and width of secondary openings and, consequently, the permeability differ from one bed to another. In a series of beds 100 feet thick there may be only one or two beds in which the secondary openings are well developed. These beds range in thickness from a few inches to a few feet; the average thickness is about 2 feet.

Because of conditions under which the rocks of the Brunswick Formation were deposited, lateral changes in the lithology take place within the formation. The rocks are a series of overlapping lens-shaped beds that are discontinuous in all directions along the plane of bedding. Examination of rock outcrops in the area indicates, however, that many of these lens-shaped beds extend for several thousand feet along strike.

The Brunswick Formation is generally a reliable source of small to moderate supplies of ground water, and in many places wells yield more than 100 gpm.

Analysis of data from 199 wells, which obtain water from only the Brunswick Formation in Montgomery and Berks Counties, indicates that there is a significant relationship between well yields and well depths. (See Fig. 2.) If yields of 100 gpm or more are desired, wells should be drilled at least 200 feet deep. According to the data shown on Figure 2, wells drilled to depths between 200 and 550 feet deep are most likely to obtain maximum yields.

For example, of 35 wells less than 185 feet deep, only 1 well yields more than 100 gpm, and only 5 yield more than 50 gpm. But 45 percent (68 of 151) of the wells between 185 feet and 550 feet deep yield more than 100 gpm, and about 75 percent (115 of 151) of them yield more than 50 gpm.

Thirty-two wells yield 200 gpm or more, and all but two of these wells are between 185 and 545 feet deep. Only seven wells yield more than 300 gpm, and all but one of these are between 200 and 510 feet deep.

Data were obtained for only 14 wells more than 550 feet deep; so, the yields of wells more than 550 feet deep are perhaps not evaluated conclusively in this report.

Data such as these can be misleading if the use of the wells is not considered, because wells drilled for domestic purposes commonly show lower yields than wells drilled for industrial use or public supply. Presumably this is because domestic water needs are small and the drilling of such wells is stopped when a small but adequate water supply is obtained. Also, many domestic wells may not be tested rigorously to determine their maximum yield. This effect of domestic wells is not believed to be significant in the data here discussed, as 174 of the 199 wells shown in Figure 2, and 24 of the 34 less than 185 feet deep, are either used as industrial or public-supply

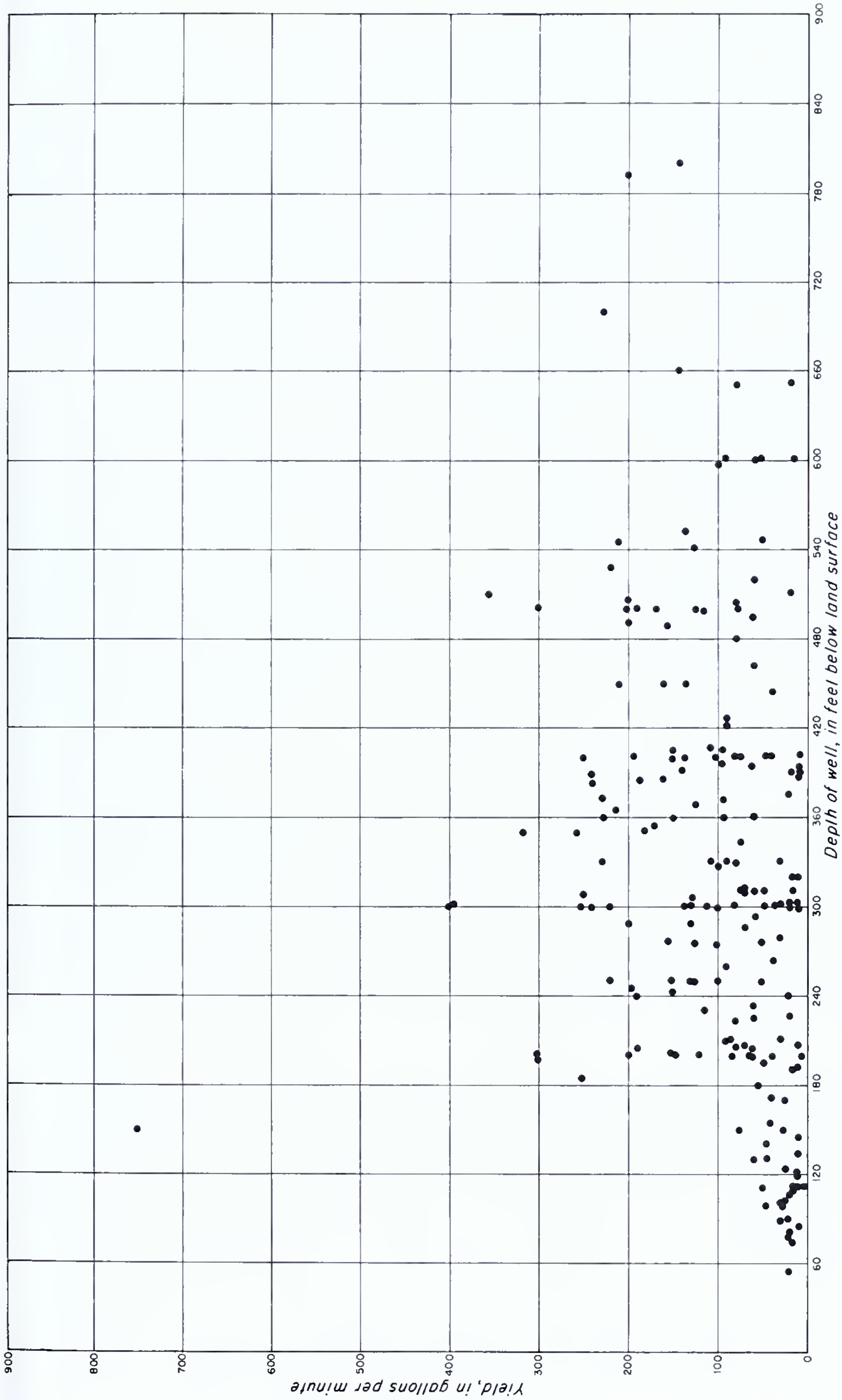



**Figure 2. Diagram showing the relation between yields and depths of wells in the Brunswick Formation.**

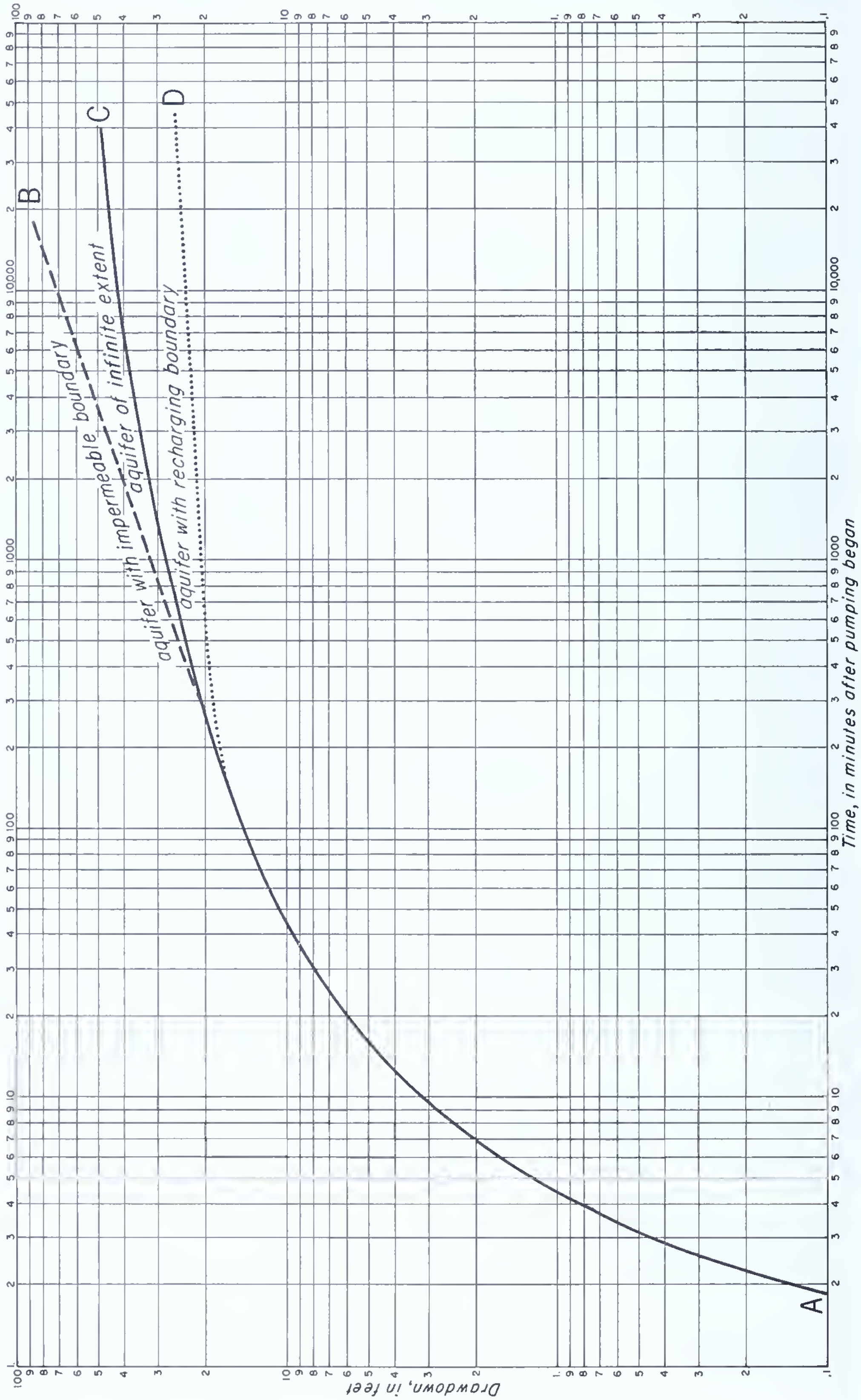



**Figure 3. Logarithmic graph of drawdown in a theoretical aquifer.**

wells or were tested for such use. The data contained in this report, therefore are believed to fairly represent the relationship of well yields versus depth of wells.

The sharply defined increase in the yield of wells at a depth of about 200 feet is believed to be the result of a rather abrupt change in the nature of rock weathering at depth. In the area of this investigation it appears that the zone of greatest decomposition—where the rock voids are believed to be partly plugged with residual clay—lies above a depth of 200 feet. Similar depths of intense weathering in the Brunswick Formation were reported by Barksdale and others (1958, p. 86).

## OCCURRENCE OF GROUND WATER IN THE LOCKATONG FORMATION

The lithology and structure of the Lockatong Formation is similar to that of the Brunswick Formation. It consists of interbedded dark-gray argillite and shale that dip to the northwest at an average angle of 20°. The rock is fine grained and well cemented. As in the Brunswick Formation, the interconnected pore spaces are very narrow and most of the ground-water flow is confined to a system of interconnected vertical joints and bedding-plane fractures. However, the fractures are narrower and more widely spaced than those in the Brunswick Formation. Yields of 15 wells that tap the Lockatong Formation ranged from 4 to 40 gpm, and the median yield was 10 gpm.

## PUMPING TESTS

When a well is pumped, water levels in the area are lowered and a cone of depression is formed in the piezometric surface or the water table. As pumping continues, the cone of depression enlarges until one of the following conditions exist: (1) The recharge of the aquifer has been increased by an amount equal to the pumping rate, (2) the natural discharge from the aquifer has been decreased by an amount equal to the pumping rate. (3) The sum of the increased recharge and decreased natural discharge is equal to the pumping rate.

Line AC on Figure 3 is a theoretical plot of drawdown against time in a well pumping at a constant rate from a homogeneous isotropic aquifer of infinite areal extent and uniform thickness. Other assumptions made in constructing the theoretieal curve are: (1) the discharge well has an infinitesimal diameter and completely penetrates the aquifer; (2) no recharge to the aquifer occurs; (3) the water withdrawn from storage in the aquifer is discharged instantaneously with decline in head; and (4) the coefficient of transmissibility is constant at all places and all times.

A plot of recovery against time would coincide with a plot of drawdown against time. If flow occurs under conditions different from those stated in

the assumptions, the plotted curve will deviate from the theoretical curve. For example, line AD in Figure 3 is one path the plotted data may follow if the cone of depression expands to a recharge boundary and induces recharge from some outside source. The slope of this curve decreases from that of the theoretical curve, indicating that drawdown has been diminished due to the inflow of recharge. If the slope of the plotted curve increases from that of the theoretical curve, as in line AB, the cone of depression has expanded to an impermeable boundary—that is, an area that is less permeable than the part of the aquifer near the pumping well. Many boundary conditions can cause this. For example, the cone of depression reaches the end of the aquifer and lateral expansion of the cone is stopped or retarded. The presence of this type of boundary may be caused by a marked decrease in the permeability of the aquifer at some distance from the well.

By means of a graphical technique that involves matching a theoretical curve to plots of drawdown in wells versus time, it is possible to compute the coefficients of transmissibility and storage for an aquifer.

The coefficient of transmissibility is a measure of the ability of the aquifer to transmit water. It is defined as the quantity of water, in gallons per day, that will flow through a vertical section of the aquifer 1-foot wide and extending the full height of the aquifer under a unit hydraulic gradient at the prevailing temperature of the water.

The coefficient of storage of an aquifer is the volume of water it releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface. Under water-table conditions, the water released from storage is obtained by draining a part of the aquifer. However, under artesian conditions, water is released from storage by compression of the network of openings within the aquifer in response to a decrease in head at a well. For this reason the coefficient of storage of an artesian aquifer is many times smaller than that of a water-table aquifer. The coefficients of storage for artesian aquifers range from 0.00001 to 0.001, and those of water-table aquifers range from 0.05 to 0.30.

Systematic aquifer tests to determine the hydraulic properties of the Brunswick Formation were made at the following locations: Kulpsville, North Wales, Spring City, Douglassville, Souderton, and Royersford. At each of these sites one well was pumped at a constant rate for a period ranging from several hours to several days while water levels were measured in the pumped well and in one or more adjacent observation wells. After pumping ceased, water levels in all these wells were measured again for an equal length of time. Results of these tests, including the coefficients of transmissibility and storage and the total drawdown during pumping, are shown in Table 1.

Table 1. Summary of pumping tests with observation wells in the Brunswick Formation.

| Area | Observation well | Date | Pumping rate (gpm) | Duration of pumping (hours) | Transmissibility T (gpd/ft) | Storage coefficient S | Boundary type | Total drawdown (feet) | Distance from pumped well |
|---|---|---|---|---|---|---|---|---|---|
| Kulpsville | Mg-631[1] | Aug. 1960 | 140 | 48 | 5,000 | | Recharge | .... | .... |
| | Mg-632 | Aug. 1960 | 140 | 48 | 43,000 | $10x10^{-5}$ | Impermeable | 10.6 | 730 |
| | Mg-633 | Aug. 1960 | 140 | 48 | 180,000 | $12x10^{-5}$ | Impermeable | 4.4 | 730 |
| North Wales | Mg-56[1] | Sept. 1960 | 127 | 4 | 1,100 | ...... | Recharge | 64.4 | .... |
| | Mg-180 | Sept. 1960 | 127 | 4 | 56,000 | $9x10^{-5}$ | Impermeable | 1.2 | 1,200 |
| | Mg-223 | Sept. 1960 | 127 | 4 | 69,000 | $10x10^{-5}$ | Impermeable | 1.1 | 1,700 |
| | Mg-223[1] | Oct. 1960 | 180 | 101 | ...... | ...... | .......... | 79 | .... |
| | Mg-56 | Oct. 1960 | 180 | 101 | 56,000 | $12x10^{-5}$ | Impermeable | 7.4 | 1,700 |
| | Mg-180 | Oct. 1960 | 180 | 101 | 82,000 | $9x10^{-5}$ | Impermeable | 13.8 | 575 |
| | Mg-167[1] | Oct. 1960 | 152 | 4 | ...... | ...... | .......... | 26.8 | .... |
| | Mg-179 | Oct. 1960 | 152 | 4 | 51,000 | $6x10^{-5}$ | Impermeable | 3.5 | 400 |
| Spring City | Ch-181[1] | Apr. 1963 | 225 | 72 | 1,000 | ...... | Recharge | 107.9 | .... |
| | Ch-144 | Apr. 1963 | 225 | 72 | 6,000 | ...... | Impermeable | 6.5 | 830 |
| | Ch-145 | Apr. 1963 | 225 | 72 | 13,000 | $29x10^{-5}$ | Impermeable | 10.3 | 1,650 |
| | Ch-147 | Apr. 1963 | 225 | 72 | ...... | ...... | .......... | 0.0 | 1,850 |
| Douglassville | Be-115[1] | July 1962 | 30 | 67 | 100 | ...... | Recharge | 112.2 | .... |
| | Be-125 | July 1962 | 30 | 67 | 600 | $3.8x10^{-5}$ | Recharge | 14.9 | 200 |
| | Be-125[1] | June 1963 | 21 | 4.5 | 1,100 | ...... | None | 18.9 | .... |
| | Be-115 | June 1963 | 21 | 4.5 | 1,500 | $3.3x10^{-5}$ | None | 7.3 | 200 |
| Souderton | Mg-665[1] | Mar. 1961 | 150 | 69 | 3,500 | ...... | Recharge | 80.5 | .... |
| | Mg-679 | Mar. 1961 | 150 | 69 | 9,000 | $4x10^{-5}$ | Impermeable | 27.6 | 400 |
| Royersford | Mg-542[1] | Jan. 1962 | 55 | 3 | ...... | ...... | .......... | .... | .... |
| | Mg-541 | Jan. 1962 | 55 | 3 | 30,000 | $6x10^{-5}$ | Impermeable | .61 | 1,200 |

[1] Pumped well.

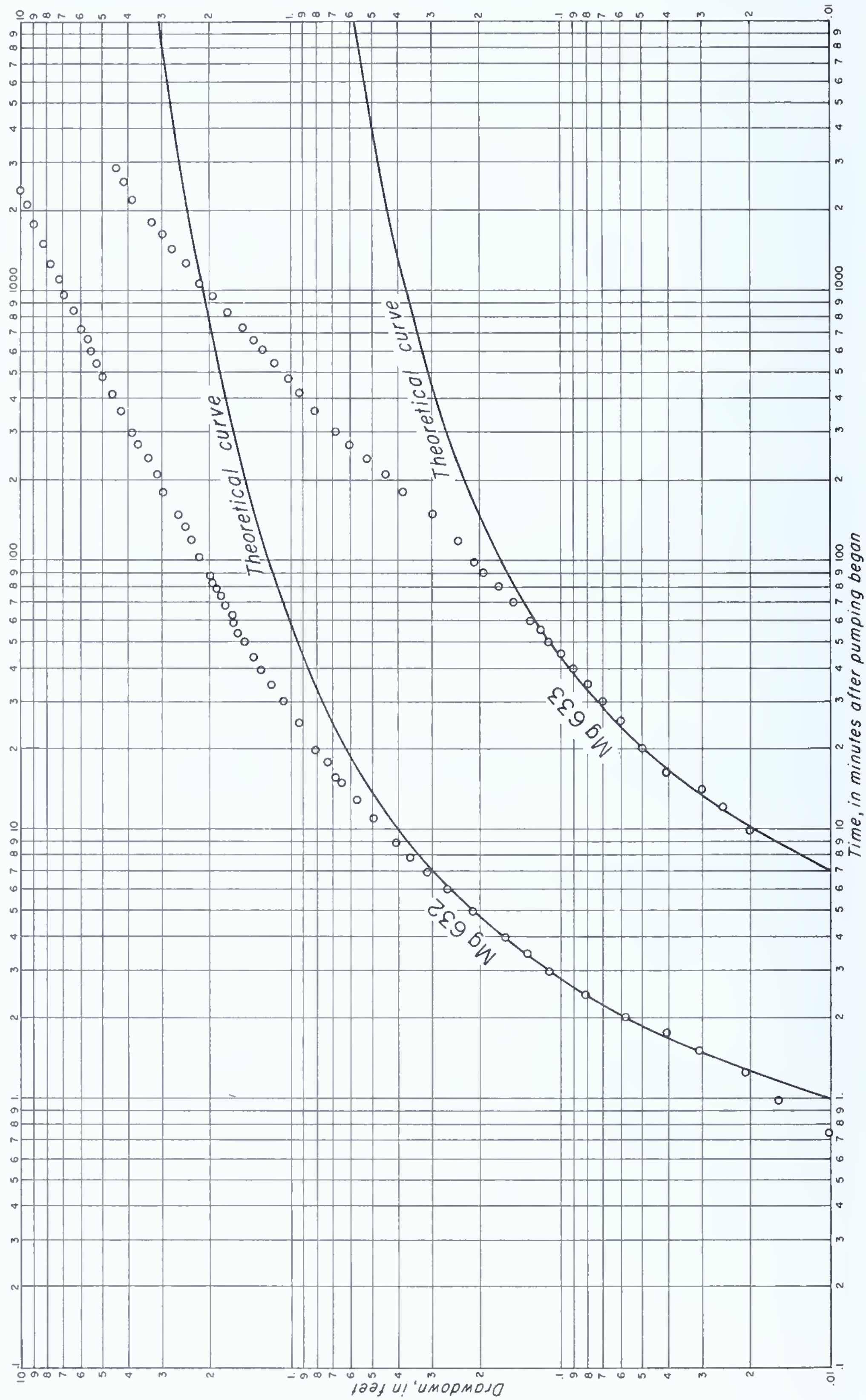



Figure 4. Logarithmic graph drawdown in wells Mg-632 and Mg-633.

Because hydrologic conditions in the Brunswick Formation do not fulfill the assumptions for an ideal aquifer, the coefficients of transmissibility and storage calculated from these tests do not truly represent the aquifers tested. Calculated transmissibility at a pumped well may be lower than the actual transmissibility of the aquifer because of well entrance losses during the test. On the other hand, excessively high transmissibilities computed at observation wells for almost all the pumping tests show clearly the poor hydraulic connection between the pumped wells and the observation wells. Despite this poor hydraulic connection, the measurement of water levels in in observation wells and the calculation of transmissibility and storage coefficients are useful for estimating the effect of pumping upon nearby wells —where the effect is controlled by recognizable geologic or topographic features.

*Tests at Kulpsville.*—In August 1960 well Mg-631, at Kulpsville, was pumped for 48 hours at a constant rate of 140 gpm and wells Mg-632 and Mg-633 were used for observation. Coefficients of transmissibility and storage calculated from these tests are shown in Table 1. Observation well Mg-632 is 730 feet from the pumped well in a direction parallel to the strike of the beds, whereas observation well Mg-633 is the same distance from the pumped well along a line perpendicular to the strike. Consequently, well Mg-632 penetrates the same strata as the pumped well, but well Mg-633 penetrates entirely different strata.

Analysis of data from these wells indicates coefficients of transmissibility of 5,000 gpd per foot at the pumped well (Mg-631), 40,000 gpd per foot at the observation well along strike (Mg-632), and 180,000 gpd per foot at the observation well perpendicular to strike (Mg-633). Poor hydraulic connection between the pumped well and the observation wells is indicated by these high transmissibilities calculated from the observation-well data. A poor hydraulic connection is especially evident at observation well Mg-633, perpendicular to the strike from the pumped well. Drawdown in this observation well is caused by leakage from beds penetrated by the observation well to beds tapped by the pumped well.

The response in observation wells Mg-632 and Mg-633 to pumping at well Mg-631 is shown in Figure 4. The graph shows that drawdown began much sooner and drawdown was much greater in the observation well (Mg-632) penetrating the same strata as the pumped well than in the observation well (Mg-633) penetrating different strata. In both observation wells water levels declined more steeply than the theoretical curve, indicating the presence of an impermeable boundary. Drawdown in the pumped well (not shown) declined more slowly than the theoretical curve, indicating the presence of a recharging boundary.

*Tests at North Wales.*—Three pumping tests were made in North Wales.

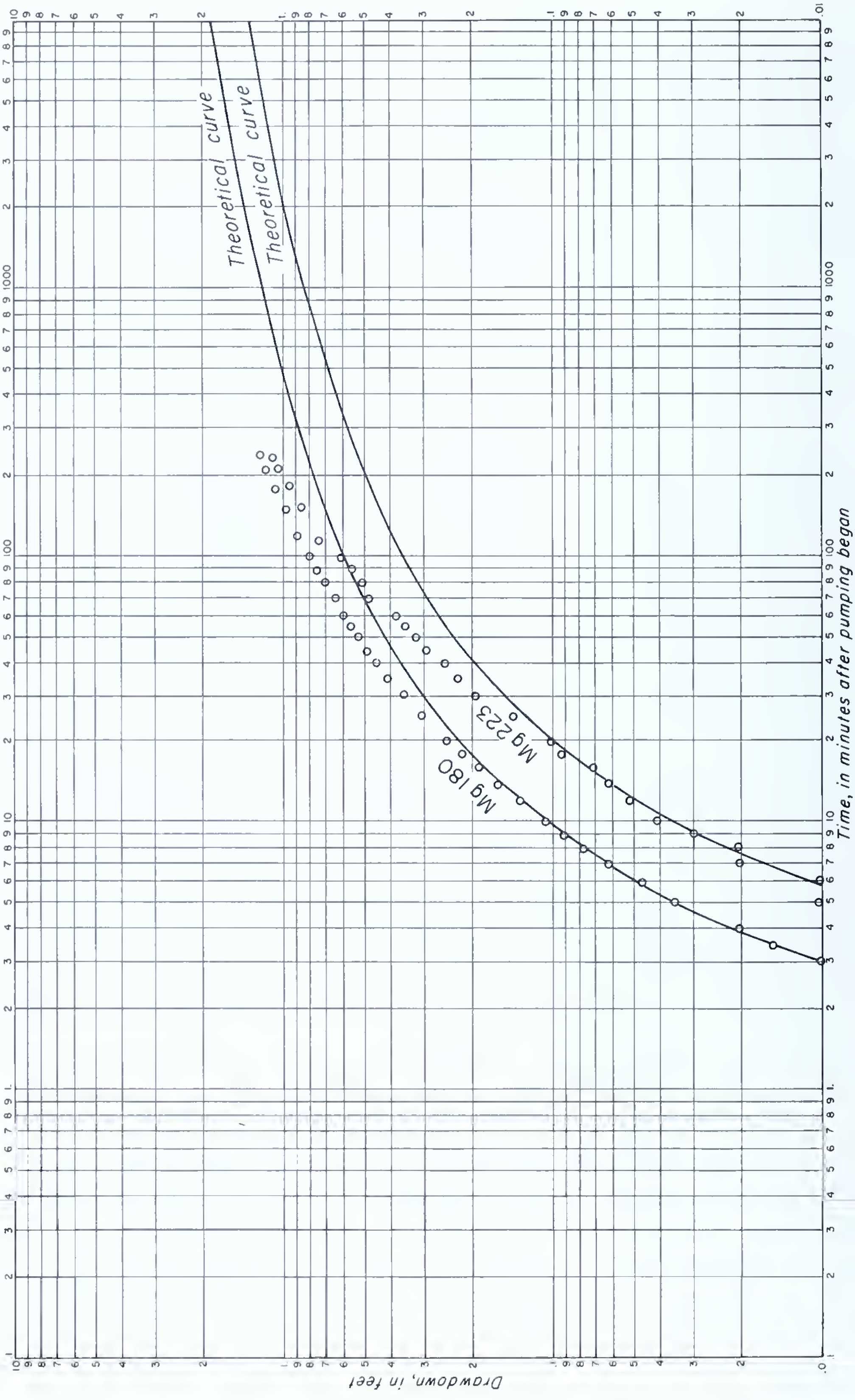



**Figure 5. Logarithmic graph of drawdown in wells Mg-180 and Mg-223.**

Coefficients of transmissibility and storage calculated from these tests are shown in Table 1. In September 1960, well Mg-56 was pumped for 4 hours at a constant rate of 127 gpm. Water levels were observed in wells Mg-167, Mg-179, Mg-180, and Mg-223.

Analysis of data from the pumped well (Mg-56) indicates a coefficient of transmissibility of 1,100 gpd per foot, which is probably lower than the actual transmissibility of the aquifer because of entrance losses at the well.

No drawdown took place at wells Mg-167 and Mg-179, which are more than 2,500 feet from the pumped well and do not penetrate the same strata as the pumped well.

The coefficient of transmissibility at observation well Mg-180, which is 1,200 feet from the pumped well, is 56,000 gpd per foot. At observation well Mg-223, which is 1,700 feet from the pumped well, the coefficient of transmissibility is 69,000 gpd per foot. The high transmissibilities at the observation wells suggest imperfect hydraulic connection with the pumped well—even though observation well Mg-223 penetrates many of the same strata as the pumped well, and well Mg-180 penetrates some of the same strata. The plots of drawdown in wells Mg-180 and Mg-223 (Fig. 5) show that drawdown started later in well Mg-223 than in well Mg-180, which was nearer to the pumped well. However, after 4 hours of pumping the drawdowns in both wells were almost identical—1.2 feet in Mg-180 and 1.1 feet in Mg-223. The drawdown plot in both observation wells indicated the presence of a discharging boundary, whereas a recharging boundary was observed in the plot of data from the pumped well, Mg-56.

In October 1960, well Mg-223 was pumped at a rate of 180 gpm for 101 hours, and wells Mg-56 and Mg-180 were used as observation wells. The calculated transmissibility was 82,000 gpd per foot at observation well Mg-180 and 56,000 gpd per foot at observation well Mg-56. Drawdown started earlier in well Mg-180, nearest the pumped well, and total drawdown was greater at this well (13.8 feet) then at well Mg-56 (7.4 feet). Drawdown data at both observation wells showed the effects of discharging boundaries.

A third pumping test conducted in October 1960, consisted of pumping well Mg-167 at a constant rate of 152 gpm for 4 hours. Water levels were measured at observation well Mg-179, which is 400 feet from the pumped well and penetrates many of the same strata. Analysis of data from observation well Mg-179 indicates a coefficient of transmissibility of 51,000 gpd per foot. The data from the pumped well were unsuitable for analysis.

*Tests in Spring City.*—Well Ch-181, at the Pennhurst State School in Spring City, was pumped at a constant rate of 225 gpm for 72 hours in April 1963. Water levels were measured at observation wells Ch-144, Ch-145, and Ch-147.

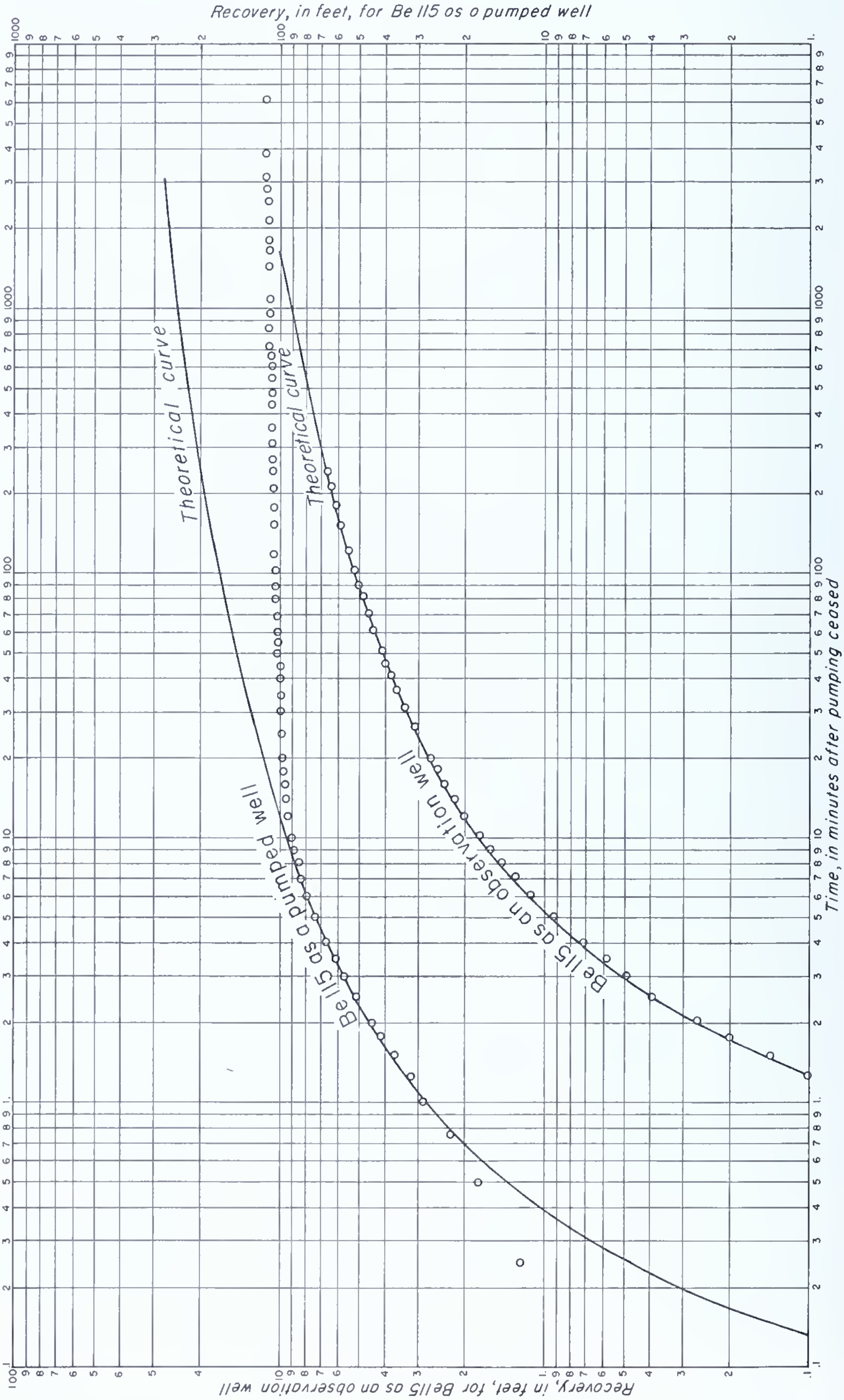



**Figure 6. Logarithmic graph of recovery in well Be-115 when used as the pumped well and when used as an observation well.**

Analysis of data from the pumped well (Ch-181) indicates a coefficient of transmissibility of 2,000 gpd per foot. Data from observation well Ch-144, which is 830 feet from the pumped well and penetrates many of the same strata, indicates a transmissibility of 6,000 gpd per foot. Data from observation well Ch-145, which is 1,650 feet from the pumped well and penetrates partly the same strata indicates a transmissibility of 13,000 gpd per foot.

The water level was not drawn down in Ch-147, although this well penetrates many of the same strata as the pumped well. This indicates the complexity of the hydrology in this area.

Drawdown commenced considerably earlier and was greater in observation well Ch-145, which was farthest from the pumped well, than in observation well Ch-144. The most distant well (Ch-145) penetrates the same strata as the lower part of the pumped well, whereas well Ch-144 penetrates the same strata as the upper part of the pumped well.

*Tests at Douglassville.*—Two pumping tests were conducted at Douglassville. In July 1962, well Be-115 was pumped at a rate of 30 gpm for 67 hours, and water levels were observed in wells Be-115 and Be-125. The two wells are 200 feet apart along the strike of the beds and are both 300 feet deep; hence, both wells penetrate the same strata. Analysis of data from these wells indicated a cofficient of transmissibility of 100 gpd per foot at the pumped well (Be-115) and 600 gpd per foot at observation well Be-125. However, when Be-125 was pumped at a rate of 21gpm for 4½ hours in June 1963, analysis of data indicated a transmissibility of 1,100 gpd per foot at Be-125 and 1,500 gpd per foot at observation well Be-115. These determinations of transmissibility are not consistent—but they do indicate a transmissibility of low magnitude.

When well Be-115 was pumped, data for both the pumped well and observation well Be-125 showed recharging boundaries. However, when well Be-125 was pumped, the data plot indicated no boundary conditions for either well. Figure 6 shows two plots of the recovery of water-level in well Be-115—one when the well was used as an observation well, and the other when it was used as the pumped well.

*Tests at Souderton.*—Well Mg-665, in Souderton, was pumped at a rate of 150 gpm for 69 hours in March 1961. Water levels were measured in well Mg-665 and in observation well Mg-679, 400 feet away. Analysis of data from this test indicated coefficients of transmissibility of 3,500 gpd per foot at well Mg-665 and 9,000 gpd per foot at well Mg-679.

Although these two wells are only 400 feet apart, a dip of 60° measured in a nearby outcrop suggests that the two wells do not penetrate the same strata. However, because all other dips measured in the Brunswick Forma-

tionare considerably less than 60°, this dip of 60° is anomalous and possibly misleading. The relatively large drawdown in the observation well (27.6 feet at the end of 69 hours), the relatively low transmissibility at the observation well as compared with transmissibilities of observation wells at other pumping sites, and the fact that the water level commenced dropping less than 1 minute after pumping began all indicate that these wells probably penetrate the same water-bearing strata.

Another pumping test was made in June 1961 when well Mg-665 was again pumped at 150 gpm for 69 hours, and well Mg-679 was again the observation well. Drawdowns in both wells were considerably greater in June than in March. Drawdown in the pumped well (Mg-665) after 69 hours pumping was 17.5 feet more in June than in March. In the observation well (Mg-679) drawdown after 69 hours was 8.1 feet greater in June than in March. A possible explanation for these differences in drawdown may be the effect of recharge from Skippack Creek, which is less than 100 feet from the wells. In March, Skippack Creek was flowing and was a possible source of induced recharge, but in June, Skippack Creek was dry and was no longer a source of recharge.

*Test at Royersford.*—Well Mg-542 at the Charles Johnson County Home, Royersford was pumped for 3 hours at a constant rate of 55 gpm in January 1962. Water-level measurements were made at observation well Mg-541, 1,200 feet northwest of the pumped well. Analysis of data from the observation well indicated a transmissibility of 30,000 gpd per foot and the occurrence of an impermeable boundary. At the end of 3 hours of pumping the water level had lowered only 0.61 feet. Because the data obtained from the pumped well was unsuitable, it was not used for analysis.

*Miscellaneous tests in the Brunswick Formation.*—In addition to the tests that involved the use of observation wells, nine pumping tests were conducted on wells which had no nearby observation wells. The results of these tests are given in Table 2. Calculated coefficients of transmissibility are generally quite low. They range from 150 to 4,000 gpd per foot and the median is 600 gpd per foot. Eight of the nine transmissibilities are less than 1,000 gpd per foot.

Data plots of six tests indicated recharge boundaries, and only one indicated a discharge boundary. One of the tests showed no boundaries, and another test showed drawdown data too irregular for determination of the boundary conditions.

*Miscellaneous tests in the Lockatong Formation.*—Pumping-test data are available from six wells tapping the Lockatong Formation. (See Table 2.) Five of these wells are in Bucks County, Pa., but results from these tests

**Table 2. Summary of pumping tests without observation wells in the Brunswick and Lockatong Formations**

| Well | Date | Pumping rate (gpm) | Duration of pumping (hours) | Transmissibility T (gpd/ft) | Boundary type |
|---|---|---|---|---|---|
| | | | **Brunswick Formation** | | |
| Be-101 | June 1963 | 13.8 | 4 | 670 | Recharge |
| 113 | June 1963 | 20 | 4 | 900 | Impermeable |
| 114 | June 1963 | 8.6 | 4 | 150 | .......... |
| Mg-581 | June 1963 | 17.7 | 4 | 600 | Recharge |
| 695 | June 1963 | 3.4 | 1 | 180 | Recharge |
| 696 | June 1961 | 5.1 | 1 | 750 | Recharge |
| 703 | June 1963 | 22.2 | 4 | 500 | Recharge |
| 725 | July 1962 | 136 | 1.25 | 4,000 | None |
| 729 | Aug. 1963 | 14.6 | 3 | 140 | Recharge |
| | | | **Lockatong Formation** | | |
| Mg-699 | June 1961 | 3.9 | 1 | 180 | None |
| Bk-807 | April 1961 | 2.0 | 1 | 70 | Impermeable |
| 814 | May 1961 | 30 | 1.2 | 2,000 | Impermeable |
| 812 | May 1961 | 5.5 | 1 | 60 | Impermeable |
| 822 | May 1961 | 4.1 | 1 | 140 | None |
| 832 | May 1961 | 2.6 | 1 | 160 | None |

are believed to be representative of the Lockatong Formation in the area covered by this report. Coefficients of transmissibility are extremely low—they range from 60 to 2,000 gpd per foot and the median is 150 gpd per foot. Five of the six wells have transmissibilities of less than 200 gpd per foot.

Discharge boundaries were encountered in three of the pumping tests. In the remaining three tests no boundary conditions were indicated.

*Discussion of pumping-test results.*—Because the Brunswick and Lockatong Formations are not ideal aquifers, coefficients of transmissibility and storage computed by matching pumping test data to the theoretical curve are not reliable. However, the pumping-tests in these formations do demonstrate the effect of pumping upon water levels in the pumped well and in nearby wells.

The high transmissibilities computed from the observation-well data reflect imperfect hydraulic connection between pumped wells and nearby wells, but they are useful for estimating the effect other pumping wells will have on water levels in their vicinities. They indicate also that interfer-

ence between wells during brief periods of pumping may be somewhat less in the Brunswick Formation than in an ideal aquifer. However, because impermeable boundaries appeared in the test data of almost all observation wells, water levels in wells near a pumping well will probably draw down to a greater extent than predicted by a transmissibility based on data from the early part of a pumping test.

Wells located on a line perpendicular to the strike of the beds will generally show much less interference than wells located on a line parallel to the strike, because the former generally do not penetrate the same strata, but the latter do. Drawdown in observation wells not penetrating the same strata as a pumped well is caused by leakage from beds penetrated by the observation wells to beds tapped by the pumped well.

## QUALITY OF WATER

All ground waters contain dissolved minerals; some contain suspended particles and pathogenic organisms. These ground-water constituents are important because if they are present in excessive amounts they may limit the usefulness of the water for some purposes and may necessitate treatment of the water.

The chemicals dissolved in ground water are obtained from many sources. Rain and snow, from which ground water is derived, absorb small amounts of carbon dioxide and other gases in the atmosphere. In addition, small particles of mineral matter in the form of dust are caught and carried along with the precipitation; the quantity of material absorbed in this way, however, is very small.

Upon reaching the land surface the water leaches mineral matter from the organic residue of plants, from agricultural fertilizers, animal and human wastes and from solid and semisolid refuse. The waters percolating downward through the soil zone leach out the soluble products of soil weathering. The quantity of mineral matter dissolved depends primarily on the composition of the soil and of the percolating water which may carry chemicals that stimulate dissolution. For example, carbon dioxide absorbed from the atmosphere and decayed vegetable matter forms carbonic acid, which aids in dissolving minerals from the soil. Other factors controlling the quantity of matter dissolved are the length of time the water is in contact with the soil, the surface drainage structure, the amount of precipitation, and the temperature of the water.

Most of the mineral matter in ground water is dissolved from the rocks through which it flows, because the water remains in contact with this material for a longer time than with the atmosphere and soil. The contact time is dependent on the ground-water velocity and the distance of the ground water from the recharge area. High ground-water velocity occurs in

rocks of high permeability or is associated with flow caused by steep hydraulic gradients—a factor often influenced by the topography. Ground-water velocity tends to decrease as depth below land surface increases, so that the quantity of dissolved solids in the ground water at great depth is usually much greater than that near the surface. The distance of the water from the recharge area is controlled by the geology and physiographic features.

Another major factor controlling the quantity of mineral matter dissolved by the ground water is the composition and texture of the rock itself. Igneous rocks generally contain material less soluble than that in sedimentary rocks. Fine-grained rocks having high porosity tend to increase the opportunity for solvent action because the surface area of rock exposed to solution is very large.

The mineral matter in ground water occurs in very small quantities and exists either as electrically charged particles known as ions or as oxides in the collodial state. Calcium (Ca), magnesium (Mg), sodium (Na), and potassium (K) are commonly occurring positively charged ions or cations. Bicarbonate ($HCO_3$), carbonate ($CO_3$), sulfate ($SO_4$), chloride (C1), fluoride (F), and nitrate ($NO_3$) are common negatively charged ions or anions. In addition to these ionized substances, small amounts of colloidal matter—including silica ($SiO_2$), iron (Fe), and manganese (Mn)—are usually present.

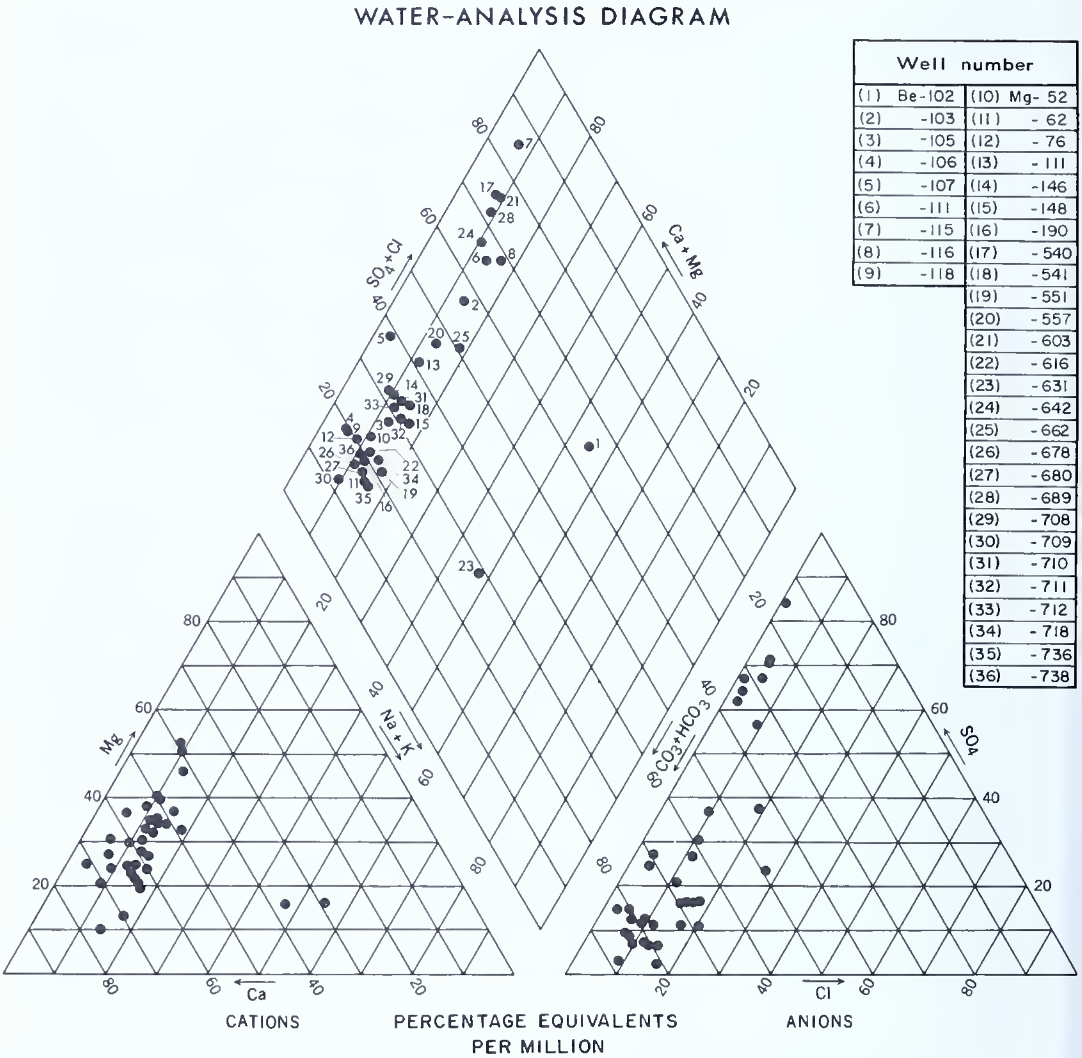
To determine the chemical constitutents of the ground water in the Brunswick and Lockatong Formations in Berks and Montgomery Counties, water samples from 36 wells in the Brunswick and 6 wells in the Lockatong were collected and analyzed. The results of these analyses are shown in Tables 3 and 4.

The chemical character of the ground water in the two formations is classified graphically on the trilinear diagrams of Figures 7 and 8.

In these diagrams the cations in solution are assumed to be calcium, magnesium, sodium, and potassium, and the anions are assumed to be bicarbonate, carbonate, sulfate, and chloride. Any minor constituents present are summed with the major constituents to which they are chemically related.

The concentration of any cation or anion in a solution, in parts per million (ppm) by weight, divided by its equivalent or combining weight yields the equivalent weight of the ion per million parts by weight of the solution and is generally termed equivalents per million (epm). Figures 7 and 8 show the percentage composition of the major cations and anions in percentage equivalents per million.

In the diamond-shaped sections of Figures 7 and 8, points plotted in the upper quarter of the diamond represent waters in which calcium and magnesium are the principal cations and sulfate and chloride are the




| Well number | | | |
|---|---|---|---|
| (1) | Be-102 | (10) | Mg- 52 |
| (2) | -103 | (11) | - 62 |
| (3) | -105 | (12) | - 76 |
| (4) | -106 | (13) | - 111 |
| (5) | -107 | (14) | -146 |
| (6) | -111 | (15) | -148 |
| (7) | -115 | (16) | -190 |
| (8) | -116 | (17) | - 540 |
| (9) | -118 | (18) | -541 |
| | | (19) | - 551 |
| | | (20) | - 557 |
| | | (21) | - 603 |
| | | (22) | - 616 |
| | | (23) | - 631 |
| | | (24) | -642 |
| | | (25) | - 662 |
| | | (26) | - 678 |
| | | (27) | - 680 |
| | | (28) | - 689 |
| | | (29) | - 708 |
| | | (30) | - 709 |
| | | (31) | - 710 |
| | | (32) | - 711 |
| | | (33) | - 712 |
| | | (34) | - 718 |
| | | (35) | - 736 |
| | | (36) | -738 |

**Figure 7. Diagram showing the chemical character of ground water in the Brunswick Formation in Berks and Montgomery Counties, Pa.**

principal anions. Those points in the left quarter of the diamond represent waters in which calcium and magnesium are the principal cations and carbonate and bicarbonate are the principal anions.

Figures 7 and 8 show that calcium and magnesium are the major cations in the ground water of both the Brunswick and Lockatong Formations. Except for two samples from the Brunswick Formation, the percentage equivalents per million of calcium plus magnesium exceeds 80 percent of the total cations present. Bicarbonate is the major anion in most of the samples in the Brunswick Formation and in all the samples in the Lockatong Formation. The percentage equivalents per million of bicarbonate exceeds 50 percent in 26 of the 36 samples from the Brunswick.

In all samples except two—those from Mg-739 in the Lockatong Formation and well Mg-631 in the Brunswick Formation—the percentage

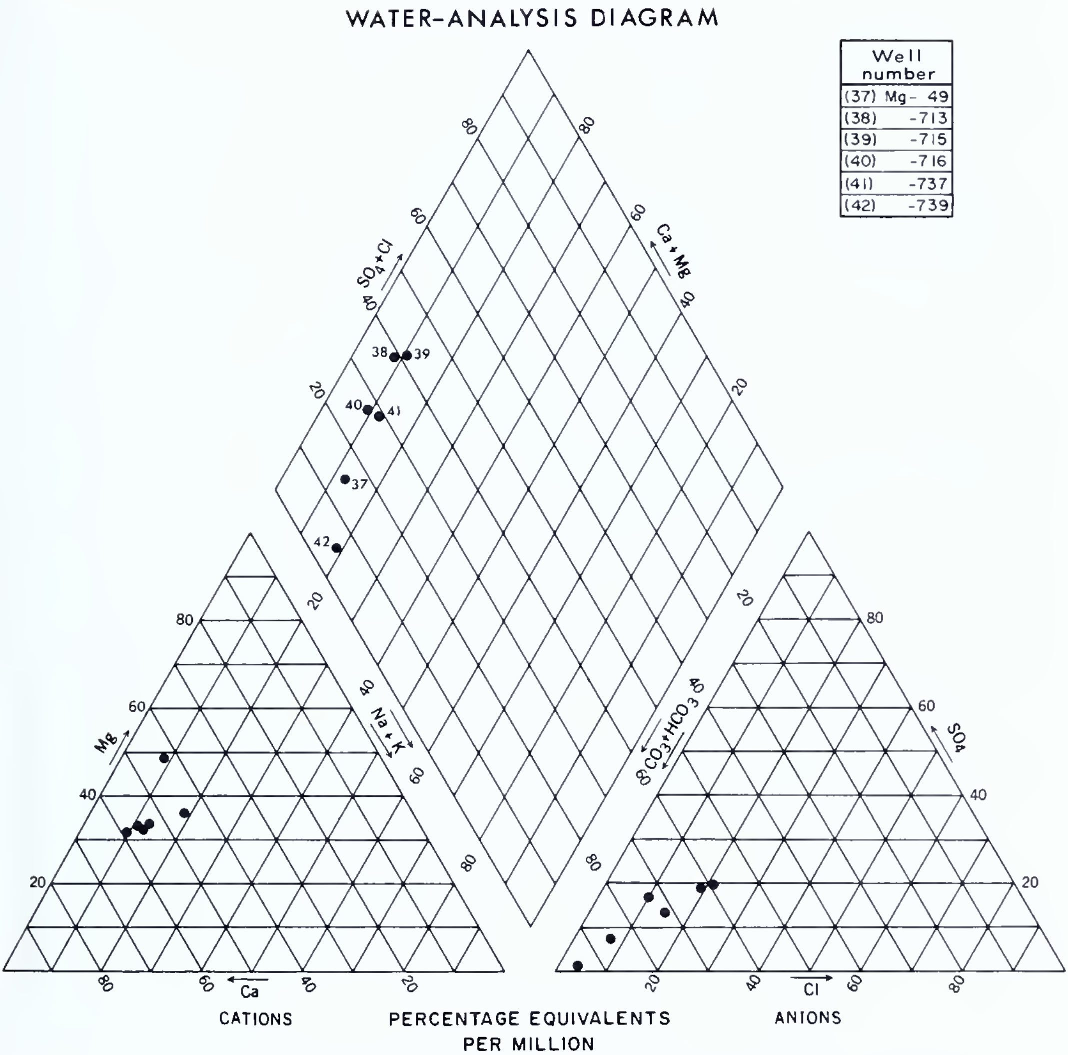



**Figure 8. Diagram showing the chemical character of ground water in the Lockatong Formation in Montgomery County, Pa.**

equivalents per million of calcium plus magnesium exceeds the percentage of bicarbonate. Therefore, some noncarbonate hardness (calcium or magnesium sulfates and chlorides) exists in all samples except these two. The relative amount of noncarbonate hardness present is indicated by the numerical difference between the percentage of calcium plus magnesium and the percentage of bicarbonate. The noncarbonate hardness for each sample is given in Tables 3 and 4.

A comparison of the chemical quality of the ground water in the two formations is shown in Table 5. The minimum, maximum, and median values were computed from the 36 Brunswick analyses and the 6 Lockatong analyses shown in Tables 3 and 4, respectively. Because the number of water samples from the Lockatong Formation in Montgomery County is small in comparison to the number from the Brunswick Formation, five

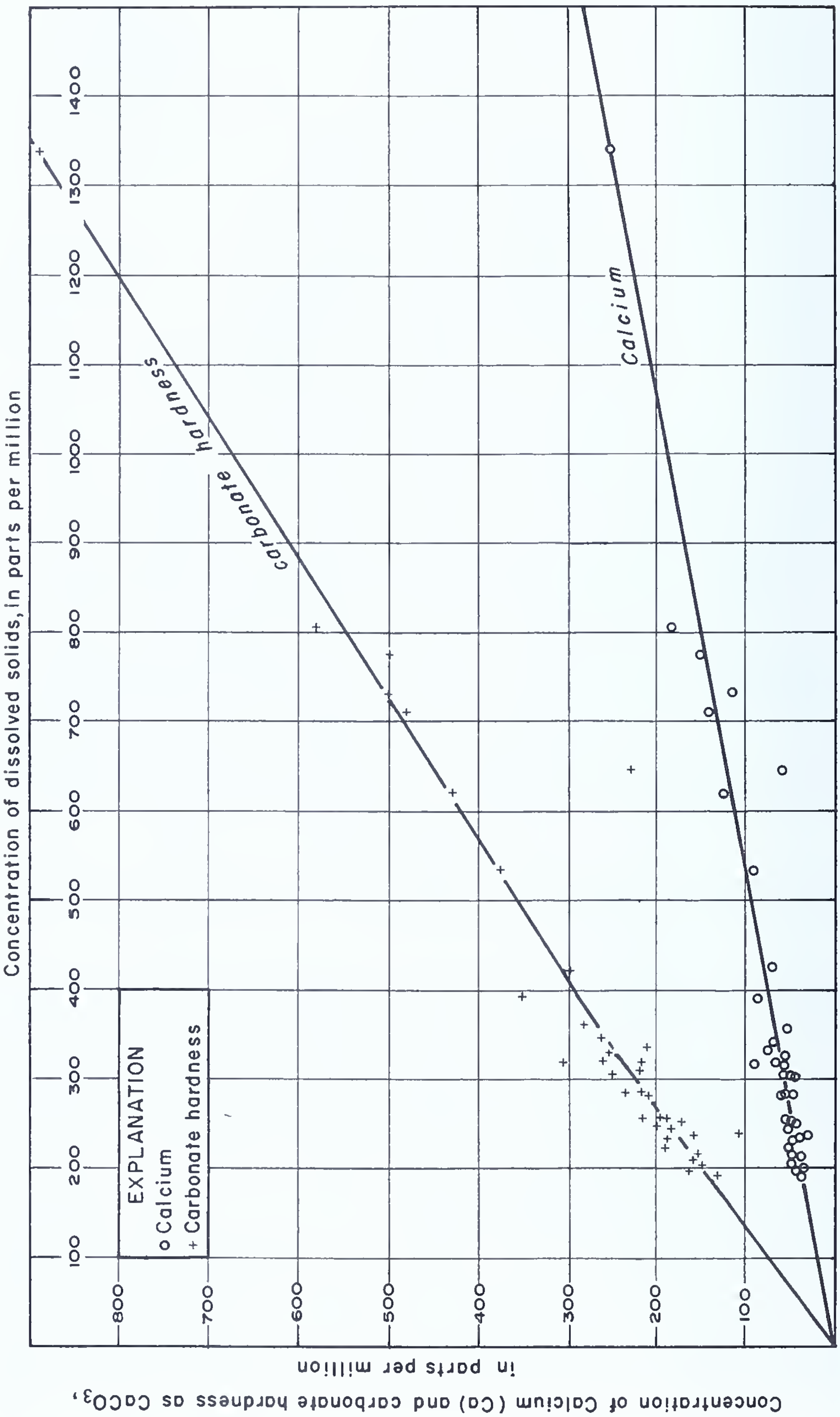



Figure 9. Relation of calcium content and carbonate hardness as $CaCO_3$ to dissolved-solids content

analyses of ground water from the Lockatong Formation in Bucks County were also studied. The minimum, maximum and median values of all eleven Lockatong analyses (Table 5) do not differ significantly from those of the six analyses from Montgomery County.

The median values of chemical constituents generally are similar in water from the Lockatong and Brunswick Formations. However, maximum concentrations of several constituents—calcium, sodium, sulfate, dissolved solids, and hardness—are considerably higher in water from the Brunswick Formation than in water from the Lockatong Formation.

Certain of the chemical constituents in the ground water of the Brunswick and Lockatong Formations are directly related to the total dissolved-solids content. In Figure 9 both the calcium content and carbonate hardness as $CaCO_3$ are plotted against the dissolved-solids content. Figure 10 shows the relation of magnesium content to dissolved solids. Figure 11 is a plot of the sodium content against the dissolved solids. The relation of bicarbonate and sulfate content to dissolved solids is shown in Figure 12.

In Figure 9 a single straight line was fitted to the plot of data showing the relation of calcium content to dissolved solids. The calcium content apparently increases linearly as the dissolved-solids content increases.

Appearing also on Figure 9 is a plot showing the relation of carbonate hardness to dissolved-solids content. Carbonate hardness can be seen to increase as dissolved-solids content increases.

Figure 10, a plot of magnesium content against dissolved solids shows that magnesium content increases rapidly as the dissolved solids rise from 200 ppm to 350 ppm. Beyond this concentration, the magnesium content does not show any clear relation to the dissolved-solids content.

Sodium content, as illustrated in Figure 11, tends to increase as dissolved-solids content increases. Figure 12 shows also that the three water samples from the limestone fanglomerate of the Brunswick Formation contain a much smaller amount of sodium than all other samples that contain comparable quantities of dissolved solids.

Figures 9, 10, and 11 illustrate that the cations responsible for increases in dissolved-solids content are calcium, magnesium, and sodium. However, because the calcium content increases much faster than the magnesium and sodium content as the dissolved solids increase, calcium is the major cation causing the increase of dissolved solids.

Figure 13 is a plot of both the bicarbonate and sulfate content against dissolved-solids concentration. The bicarbonate content does not appear to bear any significant relation to the dissolved-solids content. The sulfate content, however, increases linearly as dissolved solids increase throughout the range of dissolved solids shown. Figure 12 shows that bicarbonate is the major anion in waters containing less than 500 ppm dissolved solids,

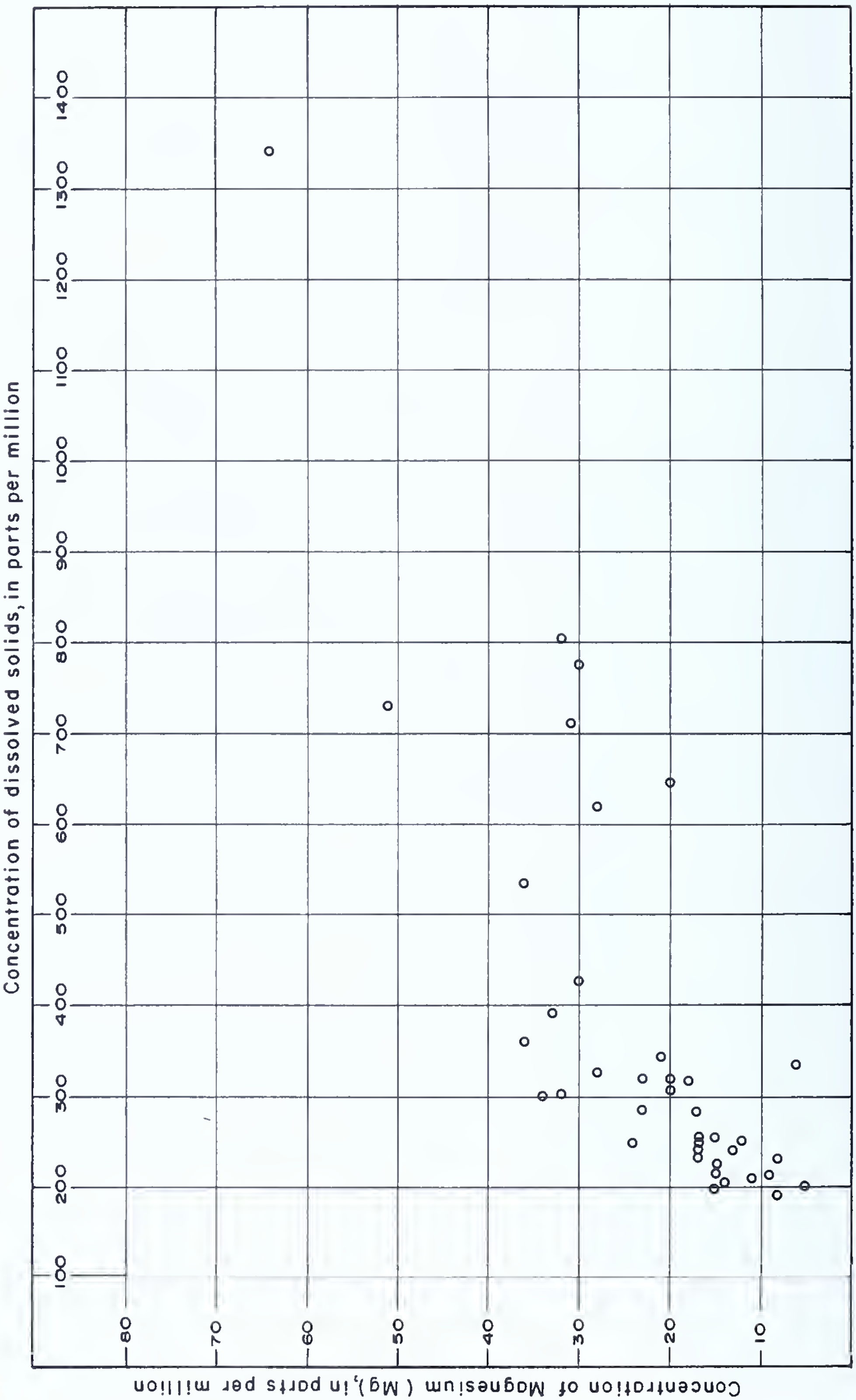



**Figure 10. Relation of magnesium content to dissolved-solids content.**

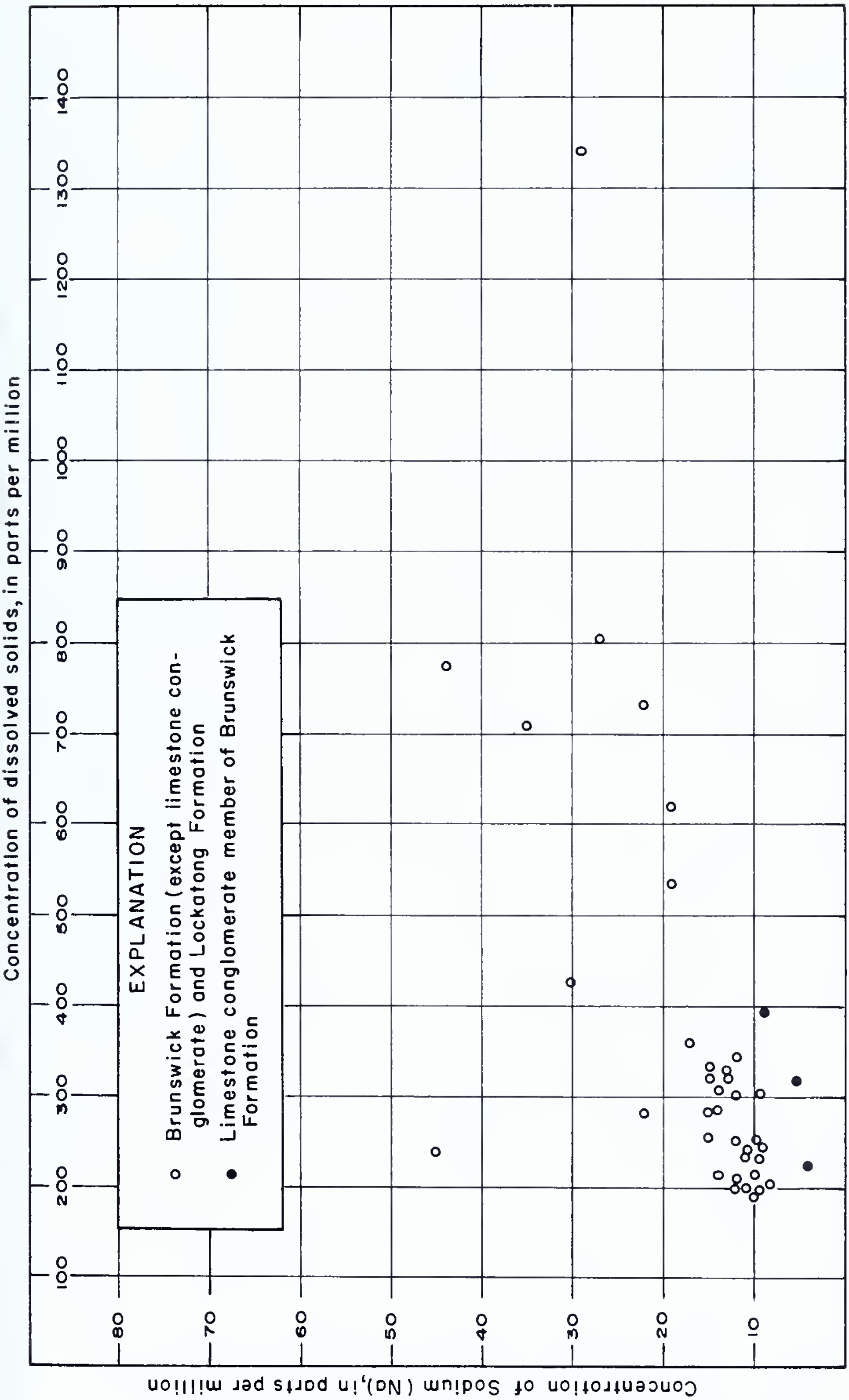



Figure 11. Relation of sodium content to dissolved-solids content.

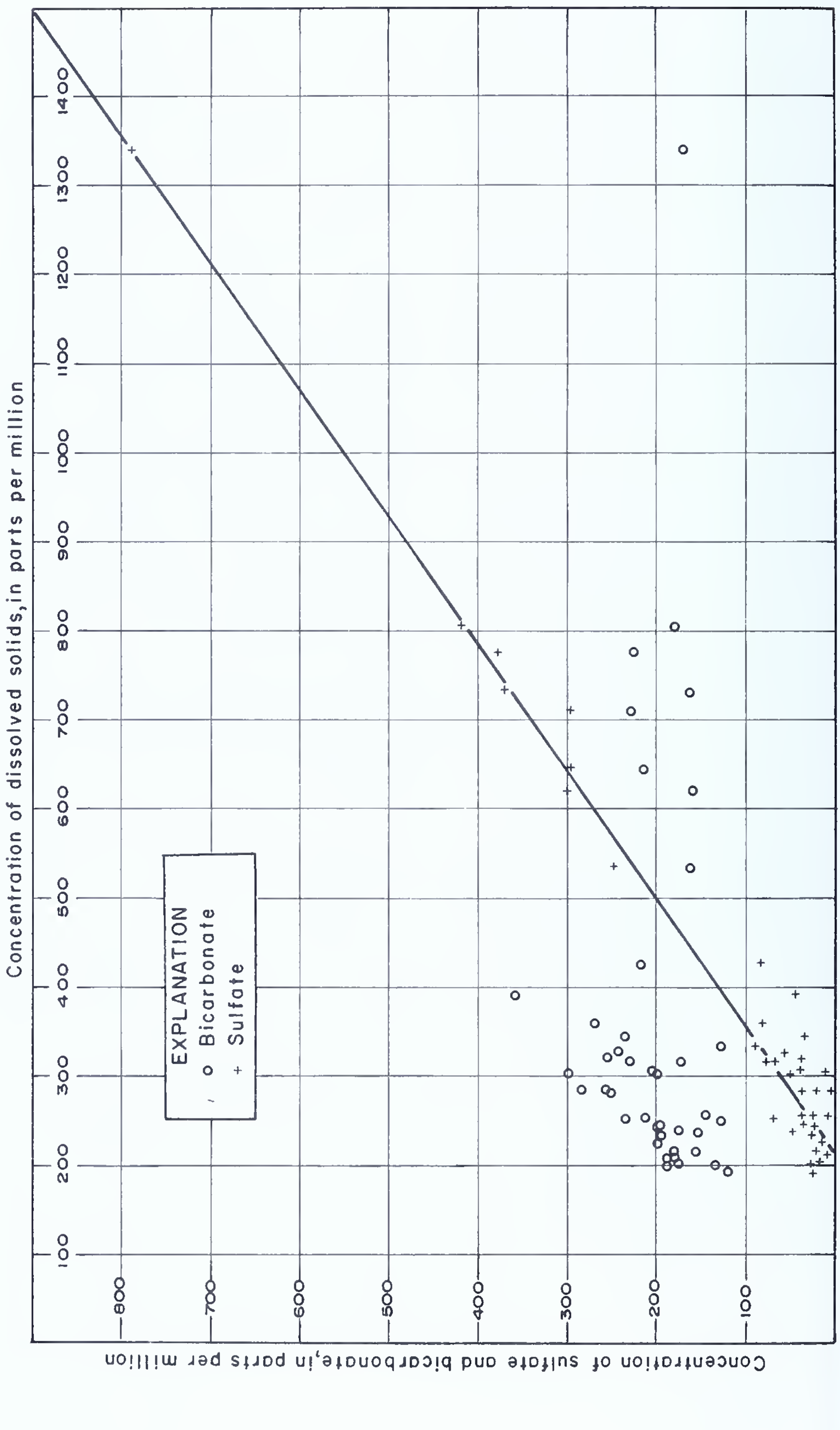



Figure 12. Relation of bicarbonate and sulfate content to dissolved-solids content.

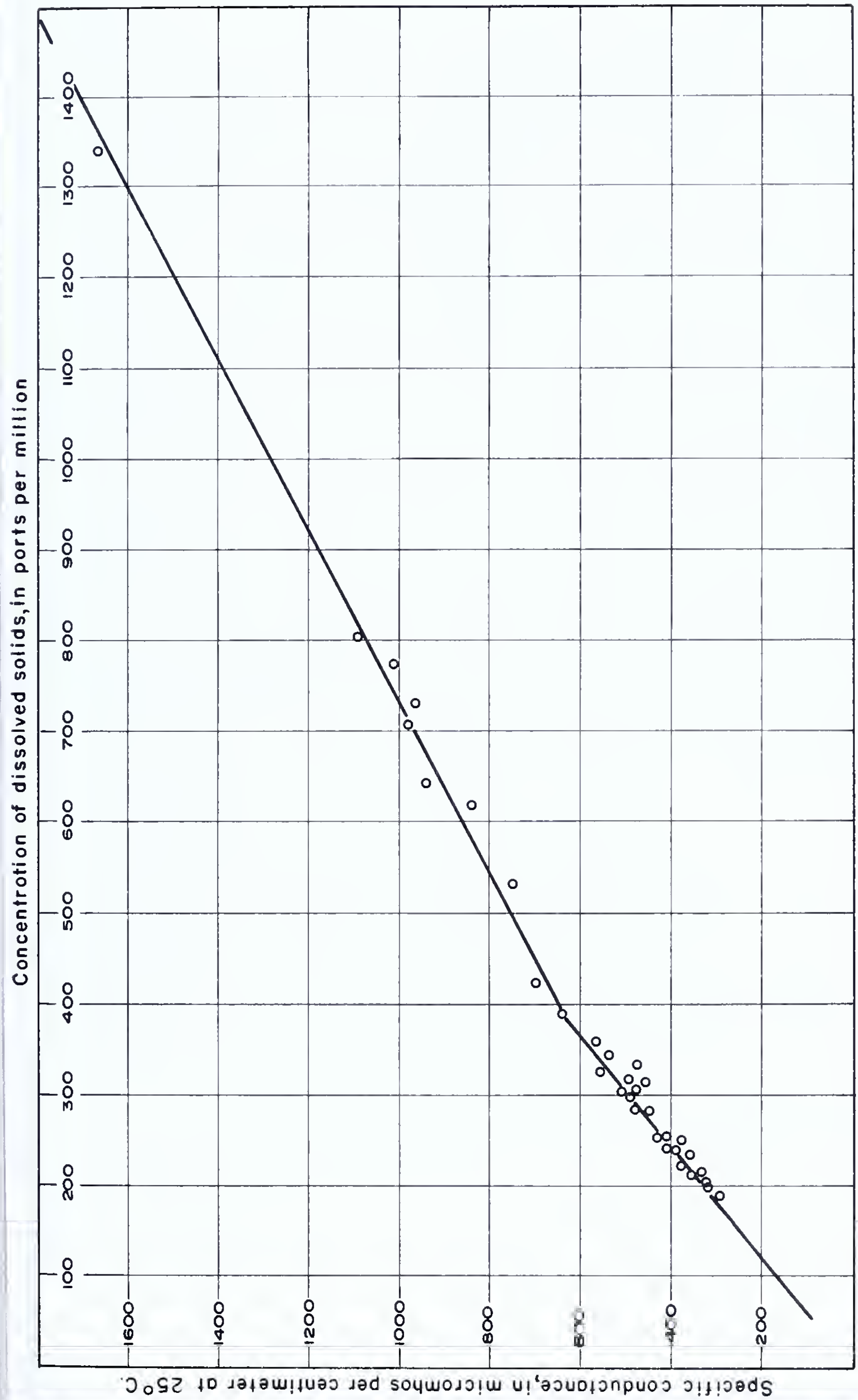



Figure 13. Relation of specific conductance to dissolved-solids content.

whereas sulfate is the major anion in waters containing more than 500 ppm dissolved solids.

The concentration of other ions present—including potassium, chloride, fluoride, and nitrate—bears no relation to the dissolved-solids content. Graphs of these constituents are not shown.

Figure 13 is a plot of the specific conductance against the dissolved-solids concentration of water from the Brunswick and Lockatong Formations. Two straight lines intersecting near 400 ppm dissolved solids were constructed to represent the relation of these two variables.

Specific conductance is defined as the electrical conductance of a cube of material one centimeter on a side and is commonly expressed as micromhos per centimeter. Specific conductance varies with temperature and is, therefore, usually referenced to the standard temperature of 25°C. Because ground-water is a dilute solution containing ionized substances, it is slightly conductive. The specific conductance of such a soluion is related to the quantity of dissolved solids that it contains.

The specific conductances used in Figure 13 were determined in a laboratory. However, with suitable portable equipment the specific conductance can be quickly and accurately measured in the field. The corresponding value of dissolved-solids content can then be estimated by using Figure13. When the dissolved-solids content is known, the probable concentration of several major ionized constituents of most ground-water samples obtained from the Brunswick and Lockatong Formations can be approximated from Figures 9, 10, 11, and 12.

## CONCLUSIONS

The yield of wells in the Brunswick Formation depends on the number, thickness, and permeability of beds penetrated. Changes in the lithology from place to place are responsible for variations encountered in well yields. Because of the erratic nature of these changes, the location and extent of the best water-bearing zones cannot be predicted; however, if yields of more than 100 gpm are desired, wells should be drilled at least 200 feet deep—as the highest yields are obtained generally from wells ranging in depth from 200 to 550 feet.

Water sufficient for domestic purposes can be obtained at almost any location, but yields large enough for industrial and municipal purposes are more difficult to obtain. To assure an adequate supply over long periods of time, consideration must be given to factors that influence both the natural and artificially induced flow of ground water. For example, the water table is generally nearer the land surface in valleys than on ridges; hence, the available drawdown at wells of equal depth is greatest for wells in valleys. As natural flow from the aquifer is generally discharged into surface

streams, the opportunity to reduce the natural discharge or to induce flow from a stream to the aquifer by means of wells is greatest in stream valleys.

Unless ground water is recovered by either reducing natural discharge, or inducing additional recharge, water withdrawn from a well reduces the quantity in storage in the aquifer. Wells that draw water from storage over long periods of time cause large cones of depression to develop. Where several pumping wells are closely spaced, the cones of depression overlap. As the total decline in water level at any well equals the sum of the drawdowns produced by each well the interference may be so great that the yield of each well is reduced. This effect is particularly severe at wells oriented along lines parallel to the strike of the beds, because these wells generally penetrate the same beds. Wells should be spaced sufficiently far apart to reduce the effect of interference to an acceptable level. Because geologic hydrologic, and pumping conditions within the Brunswick Formation are complex and variable, the best spacing of wells will differ from place to place. Wells less than 2,000 feet apart in the Brunswick Formation have generally shown some interference.

Yields greater than those required for domestic purposes are not generally available from wells in the Lockatong Formation. Furthermore, because the Lockatong Formation is very resistant to erosion, it underlies areas of high elevation which are generally remote from surface streams. Few situations exist, therefore, where ground water can readily be diverted from points of natural discharge to nearby wells in the Lockatong.

One of the best ways to improve the yield of a well in the Lockatong, or any other aquifer of low permeability, is to increase the volume of water stored in the well bore by enlarging its diameter or drilling to greater depth. Such a well permits the well operator to satisfy his need for water during short periods of peak demand. For example, the volume of storage in 100 feet of 6-inch diameter borehole is approximately 150 gallons, but the volume of storage in 100 feet of a 10-inch diameter well is more than 400 gallons. By installing the pump intake pipe near the bottom of the well, most of the water stored in the well bore can be withdrawn. During periods when water is not being withdrawn, ground water flowing into the well will replenish the stored volume—if given enough time.

The cone of depression developed by pumping wells in the Lockatong Formation is rarely extensive. For this reason interference between wells is not a severe problem.

## SELECTED REFERENCES

Barksdale, H. C. and others (1958), *Ground-water resources in the tri-state region adjacent to the lower Delaware River,* New Jersey Dept. of Conserv. and Econ. Devel., Div. Water Policy and Supply Special Rept. 13, 190 p.

Bascom, Florence and others (1931), *Geology of the Quakertown-Doylestown district, Pennsylvania and New Jersey,* U.S. Geol. Survey Bull. 828, 62 p.

——— and Stose, G. W. (1938), *Geology and mineral resources of the Honeybrook and Phoenixville quadrangles, Pennsylvania,* U.S. Geol. Survey Bull. 891, 145 p.

Buckwalter, T. V. (1959), *Precambrian geology of the Boyertown quadrangle,* Pennsylvania Geol. Survey, 4th Ser., Atlas 197, 15p.

Graham, J. B. (1945), *Occurrence of ground water in the Triassic area of Pennsylvania as influenced by geology,* Pennsylvania Water Works Operators' Assoc. Jour., v. 17, p. 86-98.

Greenman, D. W. (1955), *Ground-water resources of Bucks County, Pennsylvania,* Pennsylvania Geol. Survey, 4th Ser., Bull. W-11, 67 p.

Hall, G. M. (1934), *Ground water in southeastern Pennsylvania,* Pennsylvania Geol. Survey, 4th Ser., Bull. W-2, 255 p.

Kauffman, N. M. (1960), *Climates of the States, Pennsylvania,* U.S. Dept. of Commerce, 16 p.

Kummel, H. B. (1897), *The Newark system,* New Jersey Geol. Survey Ann. Rept. State Geol. 1896, p. 27-88.

McLaughlin, D. B. (1933), *A note on the stratigraphy of the Brunswick Formation (Newark) in Pennsylvania,* Michigan Acad. Sci., Arts, and Letters, Papers, v. 18, 1932, p. 421-435.

——— (1942), *The distribution of minor faults in the Triassic of Pennsylvania,* Michigan Acad. Sci., Arts, and Letters, Papers, v. 27, 1941, p. 465-479.

——— (1957), *in* Reeside, J. B. Jr., and others, *Correlation of the Triassic Formations of North America exclusive of Canada,* Geol. Soc. America Bull., v. 68, p. 1491-1494.

——— (1959), *in* Willard, Bradford and others, *Geology and mineral resources of Bucks County, Pennsylvania,* Pennsylvania Geol. Survey, 4th Ser., Bull. C-9, p. 55-114 and p. 126-153.

McLaughlin, D. B., and Willard, Bradford (1949), *Triassic Facies in the Delaware Valley,* Pennsylvania Acad. Sci. proc., v. 23, p. 34-44.

Rima, D. R. (1955), *Ground-water resources of the Landsdale area, Pennsylvania,* Pennsylvania Geol. Survey, 4th Ser., Prog. Rept. 146, 24 p.

——— Meisler, Harold, and Longwill, Stanley (1942), *Geology and hydrology of the Stockton Formation in southeastern Pennsylvania,* Pennsylvania Geol. Survey, 4th Ser., Bull. W-14, 111 p.

Ryan, J. D. (1959), *in* Willard, Bradford and others, *Geology and mineral resources of Bucks County, Pennsylvania,* Pennsylvania Geol. Survey 4th Ser., Bull. C-9, p. 154-162.

U.S. Department of Commerce (1962), *Climatological data, Pennsylvania.*

Van Houten, F. B. (1960), *Composition of Upper Triassic Lockatong Argillite, west-central New Jersey,* Jour. Geology, v. 68, no. 6, p. 666-669.

Van Houten, F. B. (1962), *Cyclic sedimentation and the origin of analcime-rich Upper Triassic Lockatong Formation, west-central New Jersey and adjacent Pennsylvania,* Am. Jour. Sci., v. 260, p. 561-576.

Wherry, E. T. (1959), *in* Willard, Bradford, *Geology and mineral resources of Bucks County Pennsylvania,* Pennsylvania Geol. Survey, 4th Ser., Bull. C-9, p. 114-125.

———— *Geologic map of the Triassic rocks of the Boyertown quadrangle, Pennsylvania,* unpublished map on file with Pennsylvania Geol. Survey.

## Table 3. Chemical analyses of ground water in the Brunswick Formation in Berks and Montgomery Counties, Pennsylvania

(Results in parts per million except as indicated)

| Location | Date of collection | Depth of well (ft.) | Silica ($SiO_2$) | Total iron (Fe) | Total manganese (Mn) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Dissolved solids (residue at 180° C) | Hardness as $CaCO_3$: Calcium, magnesium | Hardness as $CaCO_3$: Non-carbonate | Specific conductance (micromhos/Cm at 25°C) | pH | Color |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Berks County** | | | | | | | | | | | | | | | | | | | | |
| Be-102 | 3- 2-61 | 375 | 15 | .76 | .03 | 59 | 20 | 135 | 3.5 | 214 | 298 | 7.5 | 0.3 | 2.7 | 645 | 229 | 54 | 941 | 7.8 | 2 |
| 103 | 3- 1-61 | 119 | 26 | .03 | .02 | 75 | 6.1 | 15 | 1.5 | 128 | 89 | 13 | 0.2 | 34 | 334 | 212 | 107 | 476 | 6.8 | 2 |
| 105 | 3- 2-61 | 300 | 26 | .03 | .02 | 37 | 15 | 10 | 1.0 | 156 | 20 | 8.8 | 0.1 | 21 | 216 | 154 | 26 | 335 | 7.6 | 3 |
| 106 | 3- 3-61 | 112 | 12 | .13 | .01 | 51 | 15 | 4.1 | 2.0 | 198 | 14 | 7.5 | 0.0 | 19 | 224 | 189 | 26 | 379 | 7.3 | 3 |
| 107 | 3- 3-61 | 130 | 14 | .08 | .05 | 90 | 20 | 5.4 | 0.5 | 229 | 78 | 6.3 | 0.0 | 33 | 318 | 307 | 119 | 495 | 7.8 | 3 |
| 111 | 2- 5-62 | 528 | 15 | .23 | .02 | 141 | 31 | 35 | 1.0 | 228 | 298 | 35 | 0.3 | 3.6 | 710 | 480 | 293 | 976 | 7.8 | 3 |
| 115 | 7-19-62 | 300 | 28 | .12 | .02 | 252 | 64 | 29 | 2.0 | 168 | 788 | 5.2 | 0.0 | 4.8 | 1340 | 892 | 755 | 1660 | 7.4 | 3 |
| 116 | 1-31-62 | 360 | 25 | .37 | .09 | 151 | 30 | 44 | 2.0 | 226 | 378 | 5.8 | 0.2 | 1.7 | 775 | 500 | 315 | 1010 | 7.8 | 3 |
| 118 | 1-30-62 | 500 | 10 | 1.6 | .24 | 86 | 33 | 8.9 | 1.5 | 358 | 43 | 13 | 0.1 | 7.2 | 391 | 350 | 57 | 641 | 7.3 | 15 |
| **Montgomery County** | | | | | | | | | | | | | | | | | | | | |
| Mg- 52 | 9-25-25 | 350 | 18 | .06 | .. | 47 | 17 | 9.4 | 2.1 | 194 | 23 | 13 | .. | 7.5 | 232 | 187 | 28 | .... | .. | .. |
| 62* | 9-28-25 | 388 | 32 | .05 | .. | 36 | 15 | 11 | 1.8 | 173 | 15 | 8 | .. | 2.5 | 201 | 152 | 10 | .... | .. | .. |
| 76 | 2-21-52 | 387 | 21 | .01 | .. | 24 | 20 | 6 | 1.0 | 150 | 22 | 5 | .. | 0.4 | .... | 142 | 19 | 321 | 6.4 | 2 |
| 111 | 5-10-62 | 219 | 30 | .37 | .00 | 57 | 18 | 13 | 0.7 | 171 | 69 | 16 | 0.1 | 4.9 | 317 | 216 | 76 | 457 | 6.6 | 2 |
| 146 | 4- 7-53 | 205 | 13 | .26 | .. | 57 | 28 | 13 | 1.0 | 242 | 58 | 18 | 0.0 | 9.9 | 327 | 257 | 59 | 555 | 7.3 | 2 |
| 148 | 2- 7-62 | 373 | 17 | .07 | .00 | 45 | 5.4 | 12 | 1.0 | 134 | 26 | 10 | 0.1 | 13.0 | 200 | 135 | 25 | 313 | 7.5 | 3 |
| 190 | 2- 8-62 | 202 | 22 | .04 | .00 | 55 | 23 | 14 | 1.0 | 256 | 19 | 17 | 0.1 | 7.7 | 285 | 232 | 22 | 480 | 7.6 | 3 |
| 540 | 4- 9-62 | 600 | 20 | .44 | .02 | 116 | 51 | 22 | 0.8 | 163 | 370 | 11 | 0.1 | 11 | 732 | 500 | 366 | 959 | 7.3 | 3 |
| 541 | 3- 2-61 | 300 | 22 | .05 | .00 | 39 | 8.3 | 10 | 1.0 | 120 | 24 | 7.4 | 0.1 | 20 | 192 | 132 | 33 | 295 | 7.7 | 2 |
| 551 | 3- 1-61 | 450 | 19 | .26 | .01 | 47 | 9.0 | 14 | 1.0 | 179 | 12 | 9.3 | 0.0 | 18 | 214 | 155 | 8 | 351 | 7.8 | 2 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 557 | 4- 9-62 | 210 | 24 | .00 | .17 | 49 | 12 | 12 | 0.8 | 128 | 69 | 5.8 | 0.1 | 13 | 252 | 172 | 67 | 378 | 6.8 | 3 |
| 603 | 3- 2-61 | 916 | 28 | 3.9 | .04 | 180 | 32 | 27 | 1.0 | 180 | 420 | 18 | 0.2 | 2.8 | 805 | 581 | 433 | 1090 | 7.4 | 3 |
| 616 | 4-21-49 | 100 | 20 | .17 | . . | 52 | 13 | 11 | 1.4 | 198 | 23 | 7.0 | 0.0 | 12 | 242 | 183 | 21 | 392 | 7.5 | 3 |
| 631 | 2-28-61 | 500 | 16 | .38 | .03 | 30 | 8.2 | 45 | 0.5 | 173 | 48 | 3.5 | 0.0 | 3.7 | 239 | 109 | 0 | 378 | 8.0 | 2 |
| 642 | 3- 1-61 | 312 | 28 | .02 | .03 | 90 | 36 | 19 | 1.8 | 162 | 248 | 6.0 | 0.2 | 2.7 | 534 | 373 | 240 | 747 | 7.7 | 2 |
| 662 | 2-27-61 | 300 | 17 | .21 | .06 | 71 | 30 | 30 | 1.5 | 217 | 84 | 68 | 0.1 | 5.6 | 426 | 301 | 123 | 695 | 7.9 | 4 |
| 678 | 3- 1-61 | 300 | 24 | .06 | .04 | 39 | 14 | 8.3 | 1.0 | 178 | 17 | 4.2 | 0.0 | 8.0 | 204 | 155 | 9 | 322 | 7.7 | 2 |
| 680 | 3- 1-61 | 500 | 28 | .70 | .38 | 59 | 17 | 15 | 1.0 | 252 | 37 | 4.2 | 0.1 | 0.2 | 283 | 217 | 11 | 447 | 7.5 | 6 |
| 689 | 3- 1-61 | 300 | 32 | .02 | .05 | 126 | 28 | 19 | 2.5 | 158 | 300 | 16 | 0.6 | 0.5 | 620 | 430 | 300 | 838 | 7.6 | 3 |
| 708 | 2- 5-62 | 123 | 23 | .14 | .00 | 70 | 21 | 12 | 1.5 | 236 | 32 | 20 | 0.1 | 36 | 344 | 261 | 68 | 536 | 7.6 | 4 |
| 709 | 2- 8-62 | 80 | 23 | .05 | .00 | 44 | 34 | 12 | 1.0 | 298 | 9.7 | 5.1 | 0.1 | 20 | 302 | 250 | 6 | 490 | 8.2 | 3 |
| 710 | 2- 8-62 | 100 | 22 | .20 | .00 | 55 | 20 | 14 | 2.2 | 202 | 40 | 18 | 0.2 | 19 | 307 | 219 | 54 | 478 | 7.4 | 8 |
| 711 | 2- 8-62 | 81 | 33 | .07 | .00 | 36 | 17 | 11 | 3.0 | 152 | 29 | 13 | 0.2 | 8.8 | 236 | 160 | 36 | 359 | 7.7 | 3 |
| 712 | 2- 5-62 | 157 | 21 | 1.6 | .00 | 54 | 36 | 17 | 1.5 | 268 | 83 | 6.4 | 0.1 | 3.1 | 360 | 283 | 63 | 565 | 7.6 | 5 |
| 718 | 4- 9-62 | 133 | 19 | 3.0 | .12 | 53 | 15 | 15 | 1.5 | 211 | 27 | 13 | 0.0 | 4.0 | 255 | 194 | 21 | 429 | 6.9 | 5 |
| 736 | 9-30-25 | 111 | 23 | 4.9 | . . | 45 | 11 | 12 | 3.0 | 183 | 13 | 12 | . . | 0.88 | 209 | 158 | 8 | . . . . | . . | . . |
| 738 | 9-30-25 | 110 | 25 | 0.15 | . . | 48 | 24 | 12 | 1.2 | 234 | 6.4 | 19 | . . | 14 | 252 | 218 | 26 | . . . . | . . | . . |

* Composite sample from 3 wells (Mg-62, 63, 64).

**Table 4. Chemical analyses of ground water in the Lockatong Formation in Montgomery County, Pennsylvania**

(Results in parts per million except as indicated)

| Location | Date of collection | Depth of well (ft.) | Silica ($SiO_2$) | Total iron (Fe) | Total manganese (Mn) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Dissolved solids (residue at 180° C) | Hardness as $CaCO_3$: Calcium, magnesium | Hardness as $CaCO_3$: Non-carbonate | Specific conductance (micromhos Cm at 25°C) | pH | Color |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | **Montgomery County** | | | | | | | | | | | | |
| Mg- 49 | 9-28-25 | 157 | 25 | .07 | .. | 40 | 15 | 9.8 | 1.7 | 187 | 13 | 6.8 | .. | 5.2 | 199 | 162 | 9 | .... | .. | .. |
| 713 | 2- 9-62 | 312 | 16 | .32 | .00 | 47 | 32 | 9.5 | 1.5 | 200 | 48 | 36 | 0.2 | 0.7 | 303 | 249 | 85 | 512 | 7.8 | 3 |
| 715 | 4- 9-62 | 140 | 16 | .02 | .00 | 47 | 17 | 9.8 | 0.8 | 144 | 38 | 16 | 0.1 | 26 | 253 | 188 | 70 | 414 | 7.3 | 3 |
| 716 | 4-10-62 | 200 | 15 | .00 | .00 | 52 | 17 | 9.2 | 1.0 | 193 | 36 | 14 | 0.0 | 2.8 | 246 | 200 | 42 | 410 | 7.7 | 3 |
| 737 | 9-28-25 | 80 | 13 | .27 | .. | 66 | 23 | 15 | 2.7 | 254 | 37 | 22 | .. | 16 | 320 | 259 | 51 | .... | .. | .. |
| 739 | 9-30-25 | 490 | 13 | 17 | .. | 47 | 23 | 22 | 1.9 | 283 | 3.8 | 7.0 | .. | .21 | 283 | 212 | 0 | .... | .. | .. |

Table 5. Comparison of the chemical quality of ground water in the Brunswick and Lockatong Formations
(Results in parts per million)

| | Brunswick Formation Montgomery County | | | Lockatong Formation Montgomery County | | | Lockatong Formation Bucks and Montgomery Counties | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Median | Min. | Max. | Median | Min. | Max. | Median |
| Dissolved solids (residue at 180°C) | 192 | 1340 | 302 | 199 | 320 | 268 | 199 | 320 | 253 |
| Silica ($SiO_2$) | 10 | 33 | 22 | 13 | 25 | 16 | 11 | 25 | 15 |
| Total iron (Fe) | .00 | 4.9 | .14 | .00 | 17 | .17 | .00 | 17 | .07 |
| Total manganese (Mn) | .00 | .38 | .02 | .00 | .00 | .00 | .00 | .03 | .00 |
| Calcium (Ca) | 30 | 252 | 55 | 40 | 66 | 47 | 21 | 66 | 47 |
| Magnesium (Mg) | 5.4 | 64 | 20 | 15 | 32 | 20 | 12 | 32 | 17 |
| Sodium (Na) | 4.1 | 135 | 13 | 9.2 | 22 | 9.8 | 7 | 45 | 12 |
| Potassium (K) | 0.5 | 3.5 | 1.4 | 0.8 | 2.7 | 1.6 | 0.6 | 2.7 | 1.1 |
| Bicarbonate ($HCO_3$) | 120 | 358 | 188 | 144 | 283 | 196 | 120 | 283 | 193 |
| Sulfate ($SO_4$) | 6.4 | 788 | 38 | 3.8 | 48 | 36 | 3.8 | 61 | 37 |
| Chloride (Cl) | 3.5 | 68 | 9.7 | 6.8 | 36 | 15 | 6.8 | 36 | 11 |
| Fluoride (F) | 0.0 | 0.6 | 0.1 | 0.0 | 0.2 | 0.1 | 0.0 | 0.4 | 0.1 |
| Nitrate ($NO_3$) | 0.2 | 36 | 7.6 | .21 | 26 | 4.0 | 0.1 | 26 | 2.1 |
| Hardness Calcium, magnesium | 109 | 892 | 218 | 162 | 259 | 206 | 103 | 259 | 187 |
| Hardness Non-carbonate | 0 | 755 | 45 | 0 | 85 | 47 | 0 | 85 | 42 |
| | Analyses from 36 wells | | | Analyses from 6 wells | | | Analyses from 11 wells | | |

# Table 6. Record of wells

Method of construction: Drl, drilled.
Aquifer: TRd, diabase; TRbf, Brunswick Fanglomerate; TRb, Brunswick Formation; TRl Lockatong Formation.

Use: D, domestic; I, industrial; O, observation; PS, public supply; R, recharge; T, test; U, unused; X, destroyed.
Remarks: CA, complete chemical analysis; dd, drawdown; EL, electric log available; FA, field chemical analysis available; H, hydrograph available; SL, sample log.

| Well number | Location number | Owner | Driller | Date completed | Altitude above sea level (feet) | Method of construction | Diameter of casing (inches) | Total depth (feet) | Depth to bottom of casing (feet) | Aquifer name | Static water level: Date measured | Static water level: Depth below land surface (feet) | Yield (gpm) | Use | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Be 17 | 015–543–2 | St. Gabriel's Episcopal Church | | | 145 | Drl | 8 | 350 | | TRb | | 40 | 75 | U | |
| 18 | 015–543–3 | Roy Scherr | | | 155 | Drl | 6 | 250 | | TRb | | | 50 | D | |
| 24 | 019–537–1 | J. Y. Shaner | | | 380 | Drl | 6 | 85 | | TRb | | | 8 | U | |
| 101 | 016–548–1 | Colorado Fuel & Iron | | | 150 | Drl | 8 | 55+ | | TRb | 6– 3–63 | 17 | 20 | O | EL, H, FA; 13 ft. dd. in 3 hrs. |
| 102 | 017–547–1 | Daniel Boone Homestead | | 1939 | 200 | Drl | 6 | 375 | 40 | TRb | | | 20+ | D | CA |
| 103 | 019–538–1 | Boyertown Packaging Service | C. S. Garber | 1954 | 380 | Drl | 6 | 141 | 51 | TRb | 5–18–55 | 10 | 45+ | I | CA |
| 104 | 026–533–1 | Pennsburg Water Co. | F. L. Bollinger | 1958 | 390 | Drl | 10 | 150 | 46 | TRb | 4– 3–58 | 8 | 750 | PS | |
| 105 | 026–533–2 | do. | do. | 1958 | 395 | Drl | 10 | 300 | 49 | TRb | 4– 7–58 | 6 | 400 | PS | CA |
| 106 | 018–551–1 | Hub Tool Mfg. Machine Co. | C. S. Garber | 1958 | 240 | Drl | 10 | 112 | 83 | TRbf | | 37 | 10+ | I | CA |
| 107 | 018–544–1 | John Bell | C. S. Garber | 1955 | 355 | Drl | 6 | 119 | 40 | TRbf | 8–12–55 | 73 | 10+ | D | CA |
| 108 | 017–551–1 | Pendora Tool & Die | | | 200 | Drl | | | | TRb | | | | I | FA |
| 109 | 017–551–2 | Exeter Twp. School | Kohl Bros. | 1958 | 220 | Drl | 6 | 200 | 46 | TRb | 7–31–58 | 59 | 74 | PS | 31 ft. dd. in 6 hrs. |
| 110 | 020–537–1 | Colebrookdale School | do. | 1954 | 350 | Drl | 6 | 160 | 67 | TRb | 8– ?–54 | 15 | 68 | PS | |
| 111 | 020–536–2 | Kawecki Chemical Co. | do. | 1959 | 320 | Drl | 6 | 528 | 16 | TRb | 1959 | 110 | 220 | I | CA |
| 112 | 020–536–3 | do. | do. | 1961 | 320 | Drl | 8 | 660 | 42 | TRb | | | 140 | I | |
| 113 | 020–536–4 | do. | do. | 1961 | 320 | Drl | 6 | 500 | 35 | TRb | 6–10–63 | 26 | 20 | U | EL, H, FA; 27 ft. dd. in 4 hrs. |
| 114 | 020–536–7 | do. | C. S. Garber | 1961 | 310 | Drl | 6 | 400 | 46 | TRb | 11–14–61 | 4 | 86 | U | EL, FA; 35 ft. dd. in 4 hrs. |
| 115 | 015–544–1 | Douglassville Water Co. | do. | 1957 | 190 | Drl | 6 | 300 | 38 | TRb | 1–31–62 | 24 | 30 | U | CA; 106 ft. dd. in 67 hrs. |
| 116 | 016–544–1 | do. | do. | 1958 | 250 | Drl | 6 | 360 | 44 | TRb | 1–31–62 | 42 | 60 | PS | CA |
| 117 | 015–543–1 | do. | do. | 1959 | 219 | Drl | 6 | 262 | 42 | TRb | 1959 | 49 | 300 | PS | |
| 118 | 018–553–1 | Forest Hills Memorial Park | do. | 1959 | 295 | Drl | 6 | 500 | 38 | TRbf | 1–25–62 | 45 | 3 | D | CA, EL |
| 121 | 017–547–3 | Clarence C. Kline | Ira Petersheim | 1953 | 245 | Drl | 5 | 320 | 205 | TRb | 4–10–62 | Flows | 10 | U | EL, FA |
| 122 | 017–547–2 | do. | do. | 1953 | 225 | Drl | 10 | 335 | 6 | TRb | 7– 5–62 | 35 | | U | EL |
| 123 | 016–542–1 | Pine Forge Institute | C. S. Garber | 1947 | 240 | Drl | 6 | 240 | | TRb | | 76 | 20+ | PS | |
| 125 | 015–544–2 | U. S. Geol. Survey | Kohl Bros. | 1962 | 190 | Drl | 6 | 300 | 40 | TRb | 6– 4–63 | 37 | 20 | O | EL, H, SL; 18 ft. dd. in 4 hrs. |
| 126 | 016–542–2 | Pine Forge Institute | | | 225 | Drl | | 277 | | TRb | | | 30 | PS | |
| Ch 141 | 011–533–1 | Pennhurst State School | | | 235 | Drl | 8 | 327 | | TRb | 1948 | 52 | 100 | PS | 218 ft. dd. in 3 hrs. |
| 142 | 011–533–2 | do. | | | 230 | Drl | 8 | 529 | | TRb | 1954 | 190 | 60 | PS | 40 ft. dd. in 3 hrs. |
| 143 | 011–533–3 | do. | | | 320 | Drl | 8 | 443 | | TRb | 3–12–63 | 236 | 40 | U | |
| 144 | 011–534–1 | do. | | | 310 | Drl | 8 | 421 | | TRb | 1–23–56 | 115 | 80 | PS | |
| 145 | 011–534–2 | do. | | | 330 | Drl | 8 | 404 | | TRb | 3–12–63 | 212 | 95 | PS | 75 ft. dd. in 7 hrs. |
| 146 | 011–534–3 | do. | | | 345 | Drl | | | | TRb | | | | X | |
| 147 | 011–533–4 | do. | F. L. Bollinger | | 295 | Drl | 12 | 804 | 74 | TRb | 6– ?–48 | 101 | 200 | PS | 60 ft. dd. in 3 hrs. |
| 181 | 011–534–4 | do. | do. | 1963 | 260 | Drl | 16–10 | 700 | 90 | TRb | 4– 9–63 | 130 | 225 | PS | 108 ft. dd. in 72 hrs. |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mg | 1 | 013–526–1 | Eastern State Penitentiary | | | 140 | Dug | | 22 | | Trb | 10–28–31 | 18 | | X | H |
| | 2 | 014–539–2 | Pottsgrove Manor | | 1752 | 158 | Dug | 48 | 30 | | Trb | 10–28–47 | 28 | | O | |
| | 3 | 014–527–1 | Gottfried Ott | | | 170 | Dug | 48 | 29 | | Trb | 10–27–47 | 19 | | U | |
| | 4 | 011–528–1 | Collegeville-Trappe Joint Water Works | Honenberger | 1936 | 195 | Drl | 12–8 | 275 | 34 | Trb | 4–13–50 | 24 | 125 | U | 84 ft. dd. in 24 hrs. |
| | 5 | 011–528–2 | do. | Kohl Bros. | 1935 | 195 | Drl | 12–8 | 250 | 42 | Trb | 10–31–35 | 15 | 200–240 | PS | 49 ft. dd. in 24 hrs. |
| | 6 | 011–528–3 | do. | do. | 1942 | 180 | Drl | 8 | 250 | 40 | Trb | 5– 6–43 | 15 | 150 | PS | 40 ft. dd. in 4 hrs. |
| | 7 | 011–528–4 | do. | do. | 1947 | 190 | Drl | 8 | 367 | 6 | Trb | 9– 2–47 | 40 | 125 | U | |
| | 8 | 011–528–5 | do. | do. | 1947 | 210 | Drl | 8–6 | 357 | 41 | Trb | 12–28–47 | 26 | 148 | PS | 99 ft. dd. in 24 hrs. |
| | 49 | 012–516–2 | North Wales Water Authority | Ridpath & Potter | 1906 | 391 | Drl | 8 | 158 | 45 | Trb, Trl | | | 100 | U | CA |
| | 52 | 012–516–3 | do. | do. | | 350 | Drl | 8 | 350 | 30 | Trb, Trl | | | 80 | PS | CA |
| | 56 | 012–517–1 | do. | | 1945 | 320 | Drl | 14–10 | 384 | 72 | Trb | 4–23–45 | 0 | 240 | PS | 135 ft. dd. in 24 hrs. |
| | 61 | 014–516–1 | Lansdale Municipal Authority | | 1892 | 366 | Drl | 8 | 392 | | Trb | 8– 6–54 | 79 | 8 | U | |
| | 62 | 014–516–2 | do. | | 1903 | 366 | Drl | 8 | 388 | 22 | Trb | 8– 6–54 | 76 | 8 | U | CA |
| | 63 | 014–516–3 | do. | | 1908 | 366 | Drl | 8 | 400 | 120 | Trb | 3– 1–43 | 78 | 18 | U | CA |
| | 64 | 014–516–4 | Lansdale Municipal Authority | | 1910 | 366 | Drl | 8 | 1108 | 18 | Trb | 11– 4–54 | 83 | 8 | U | CA |
| | 67 | 014–517–1 | do. | F. L. Bollinger | 1923 | 328 | Drl | 8 | 292 | | Trb | 3– 1–47 | 132 | 57 | PS | |
| | 68 | 014–517–2 | do. | do. | 1927 | 322 | Drl | 8 | 500 | | Trb | 1–31–47 | 83 | 79 | PS | |
| | 69 | 014–517–3 | do. | William Stothoff | 1935 | 328 | Drl | 12–8 | 264 | 40 | Trb | 1–31–47 | 73 | 39 | PS | |
| | 70 | 014–516–8 | do. | do. | 1937 | 421 | Drl | 10–8 | 391 | 36 | Trb | 1–31–47 | 84 | 139 | PS | 129 ft. dd. in 48 hrs. |
| | 72 | 013–516–1 | do. | do. | 1941 | 353 | Drl | 16–10 | 306 | 44 | Trb | 3– 1–47 | 42 | 128 | PS | |
| | 74 | 014–515–5 | do. | do. | 1948 | 403 | Drl | 12–10 | 546 | | Trb | 2–24–48 | 48 | 50 | U | |
| | 76 | 013–516–2 | do. | do. | 1949 | 341 | Drl | 12–10 | 388 | 37 | Trb | 7–18–49 | 23 | 240 | PS | CA |
| | 83 | 014–517–4 | Lansdale Forest Products Co. | F. L. Bollinger | 1934 | 330 | Drl | 8 | 425 | | Trb | 11–18–52 | 74 | | U | |
| | 85 | 014–517–5 | Lansdale Ice & Storage | | | 360 | Drl | 8 | 615 | | Trb | 11–18–52 | 66 | | U | |
| | 90 | 013–517–1 | Lansdale Tube Co. | Philadelphia Drilling Co. | 1951 | 375 | Drl | 8 | 500 | 46 | Trb | 1–17–51 | 57 | 165 | I | |
| | 91 | 014–538–18 | Joseph Prince | | 1913 | 190 | Drl | 6 | 299 | | Trb | 10–23–52 | 59 | | U | |
| | 92 | 014–538–19 | Schulz Baking Co. | | 1932 | 190 | Drl | 8 | 242 | | Trb | 11– 1–44 | 70 | 150 | I | 69 ft. dd. in 48 hrs. |
| | 93 | 015–538–1 | Raymond Nester | | 1916 | 165 | Drl | 6 | 150 | | Trb | | | 76 | I | |
| | 94 | 014–538–15 | Clover Leaf Dairy | Penrose Keller | 1926 | 175 | Drl | 6 | 125 | | Trb | | | | I | |
| | 95 | 014–538–16 | do. | do. | 1928 | 170 | Drl | 6 | 125 | | Trb | | | | I | |
| | 96 | 014–538–17 | do. | C. S. Garber | 1935 | 160 | Drl | 8 | 276 | | Trb | 3– ?–47 | 55 | 50 | I | 2 ft. dd. in 14 hrs. |
| | 97 | 014–538–13 | Pottstown Warehouse & Cold Stor. Co. | Groff | 1937 | 150 | Drl | 8 | 250 | 100 | Trb | 6–17–47 | 20 | 125 | I | |
| | 98 | 014–538–14 | do. | Groff & Kohl Bros. | 1938 | 150 | Drl | 8 | 800 | 120 | Trb | 6–17–47 | 20 | 140 | I | |
| | 99 | 014–538–20 | Pottstown Plating Works Inc. | C. S. Garber | 1943 | 135 | Drl | 8 | 230 | | Trb | 1950 | 24 | 115 | I | 76 ft. dd. in 40 hrs. |
| | 100 | 014–538–21 | do. | do. | 1951 | 135 | Drl | 8 | 545 | 40 | Trb | 8– ?–51 | 45 | 210 | I | 90 ft. dd. in 24 hrs. |
| | 101 | 014–538–7 | Doehler-Jarvis Corp. | Penrose Keller | | 160 | Drl | 8 | 90 | | Trb | 6– 3–55 | 51 | | O | |
| | 102 | 014–538–8 | do. | Joseph Smith | 1936 | 155 | Drl | 8 | 300–320 | | Trb | 6– 2–55 | 53 | | U | |
| | 103 | 014–538–9 | do. | do. | 1937 | 155 | Drl | 8 | 300–320 | | Trb | | | 72 | I | |
| | 104 | 014–538–10 | Doehler-Jarvis Corp. | do. | 1937 | 155 | Drl | 8 | 300–320 | | Trb | | | 48 | I | |
| | 105 | 014–538–11 | do. | do. | 1938 | 155 | Drl | 8 | 300–320 | | Trb | | | 71 | I | |
| | 106 | 014–538–12 | do. | do. | 1940 | 155 | Drl | 8 | 300–320 | | Trb | | | 59 | I | |
| | 107 | 014–538–5 | Minneapolis-Honeywell Regulator Co. | C. S. Garber | 1943 | 145 | Drl | 8 | 300 | | Trb | | | 220 | I | |
| | 108 | 014–538–6 | Philadelphia Dry Cleaners Inc. | Joseph Smith | 1930 | 150 | Drl | 6 | 199 | | Trb | 10– ?–50 | 18 | 60+ | I | |
| | 110 | 014–541–1 | Pottstown Cement Block Co. | C. S. Garber | 1941 | 170 | Drl | 8 | 112 | | Trb | 1941 | 15 | 15 | I | |
| | 111 | 014–541–2 | Pottstown Metal Products Co. | do. | 1941 | 165 | Drl | 6 | 219 | | Trb | | 34 | 90 | I | CA |
| | 112 | 014–541–3 | do. | Charles Merritt | 1951 | 165 | Drl | 6 | 120 | | Trb | | 34 | 9 | I | |
| | 123 | 012–518–1 | Merk, Sharpe & Dohme | F. L. Bollinger | 1942 | 362 | Drl | 10–6 | 502 | | Trb, Trl | 5–14–51 | 34 | 15 | U | |
| | 127 | 013–518–3 | do. | Charles Lauman | | 351 | Drl | 12–10 | 300 | | Trb | 11– 3–53 | 53 | 130 | O | |
| | 128 | 013–518–4 | do. | do. | | 352 | Drl | 12–10 | 300 | | Trb | 11– 3–53 | 58 | 395 | I | |
| | 146 | 019–519–2 | Telford Borough | Ridpath & Potter | 1928 | 420 | Drl | 10 | 205 | | Trb | 9–16–56 | 90 | 190 | PS | CA |
| | 148 | 012–528–1 | Collegeville-Trappe Joint Water Works | Kohl Bros. | 1954 | 225 | Drl | 8 | 373 | 33 | Trb | 8– 4–54 | 8 | 227 | PS | CA; 110 ft. dd. in 24 hrs. |
| | 152 | 015–516–1 | American Encaustic Tile Co. | | 1929 | 365 | Drl | 8 | 203 | 25 | Trb | 5– ?–54 | 98 | 60 | I | 60 ft. dd. in 1 hr. |
| | 153 | 015–516–3 | do. | | 1954 | 365 | Drl | 10 | 400 | | Trb | 1– ?–54 | 101 | 80 | I | |

# Table 6. Record of wells—Continued

| Well number | Location number | Owner | Driller | Date completed | Altitude above sea level (feet) | Method of construction | Diameter of casing (inches) | Total depth (feet) | Depth to bottom of casing (feet) | Aquifer name | Static water level: Date measured | Static water level: Depth below land surface (feet) | Yield (gpm) | Use | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mg 167 | 012–516–1 | Leeds & Northrup Co. | Ridpath & Potter | 1954 | 350 | Drl | 16–10 | 288 | 44 | TRb | 5– ?–60 | 48 | 200 | I | |
| 179 | 012–516–4 | do. | | | 358 | Drl | 8 | 126 | 60 | TRb, TRl | 1– ?–47 | 10 | 100 | U | EL, H |
| 180 | 013–517–2 | do. | Ridpath & Potter | 1954 | 325 | Drl | 6 | 250 | | TRb | 11– 2–54 | 65 | 100 | U | EL, H |
| 190 | 016–518–1 | Hatfield Borough | J. T. Campbell | 1928 | 350 | Drl | 8 | 202 | 36 | TRb | | | 150 | PS | CA |
| 203 | 012–517–2 | North Wales Water Authority | Kohl Bros. | 1955 | 315 | Drl | 8 | 450 | 27 | TRb | 1–17–55 | 12 | 210 | PS | 188 ft. dd. in 72 hrs. |
| 204 | 013–517–3 | Precision Tube Co. | Philadelphia Drilling Co. | 1955 | 365 | Drl | 8 | 500 | | TRb | 5–19–55 | 52 | 190 | I | 22 ft. dd. in 5 hrs. |
| 221 | 011–532–3 | Krasley Bleach & Dye | Kohl Bros. | 1941 | 130 | Drl | 8 | 447 | 22 | TRb | | | 80 | U | |
| 222 | 011–532–4 | do. | do. | 1941 | 130 | Drl | 8 | 251 | 28 | TRb | | 23 | 135 | I | |
| 223 | 013–517–4 | Leeds & Northrup Co. | Ridpath & Potter | 1955 | 332 | Drl | 10 | 350 | | TRb | 8– ?–55 | 49 | 316 | I | FA; 81 ft. dd. in 48 hrs. |
| 257 | 011–517–1 | C. W. MacMullin | George Lauman | 1950 | 340 | Drl | 6 | 65 | | TRl | 11– 9–55 | 22 | 10 | D | |
| 258 | 011–517–2 | John F. Gerber | | 1948 | 385 | Drl | 6 | 80+ | | TRl | | | 10 | D | |
| 274 | 014–539–1 | Pottstown Metal Welding Co. | Michael Kuszyk | 1956 | 135 | Drl | 8 | 150 | | TRb | | | | I | |
| 281 | 011–526–1 | Superior Tube Co. | Kohl Bros. | | 190 | Drl | 6 | 460 | 105 | TRb | | | 60 | I | |
| 282 | 011–526–2 | do. | do. | 1941 | 190 | Drl | 8 | 300 | 61 | TRb | 10– ?–41 | 57 | 110 | I | |
| 283 | 011–526–3 | do. | do. | 1951 | 185 | Drl | 8 | 199 | 101 | TRb | 10–23–56 | 87 | 87 | I | |
| 284 | 011–526–4 | do. | do. | 1953 | 185 | Drl | 8 | 449 | 22 | TRb | 9– ?–53 | 86 | 55 | I | |
| 292 | 018–521–2 | Horace W. Longacre | A. W. Dorn | 1956 | 390 | Drl | 6 | 131 | 38 | TRb | 11– 8–56 | 50 | 45 | I | |
| 293 | 014–534–1 | Saratoga Trailer Park | | 1946 | 260 | Drl | 6 | 226 | | TRb | 1956 | 87 | 20+ | PS | |
| 450 | 011–521–1 | Variety Club Camp | | | 410 | Drl | | 175 | | TRb, TRl | | | | D | |
| 467 | 011–521–2 | do. | Parente Bros. | 1949 | 420 | Drl | | 225 | | TRb, TRl | | | | PS | |
| 472 | 010–520–1 | P. W. Bookhermer | Charles Lauman | 1945 | 450 | Drl | | 110 | | TRb, TRl | | | | D | |
| 473 | 010–519–1 | B. Bev | do. | 1950 | 350 | Drl | | 120 | | TRl | | | 4 | D | |
| 478 | 011–518–1 | F. McClure | do. | 1944 | 325 | Drl | | 150 | | TRl | 9– 6–56 | 10 | 7 | D | |
| 479 | 011–517–3 | E. W. Carlson | | | 330 | Drl | | 160 | | TRl | | | | D | |
| 480 | 011–518–2 | W. A. Garver | | 1930 | 375 | Drl | | 90+ | | TRb, TRl | | | | D | |
| 481 | 011–518–3 | A. J. Wilson | Patrick Flaherty | 1950 | 417 | Drl | 6 | 112 | 30 | TRl | 9– 6–56 | 69 | 27 | D | |
| 482 | 011–518–4 | Henry Krug | | 1949 | 370 | Drl | | 120 | | TRl | | | | D | |
| 483 | 011–518–5 | Joseph Bailiff | | 1943 | 360 | Drl | 6 | 132 | 25 | TRl | 9–25–56 | 60 | 12 | D | |
| 493 | 010–520–2 | U. S. Army | C. S. Garber | 1955 | 445 | Drl | | 230 | | TRl | | 47 | 7 | | |
| 494 | 010–521–1 | do. | do. | 1955 | 460 | Drl | | 230 | | TRl | | 51 | 22 | | |
| 498 | 015–518–1 | Lansdale Municipal Authority | William Stothoff | 1957 | 340 | Drl | 12 | 560 | 90 | TRb | 9–18–57 | 77 | 90 | PS | |
| 534 | 013–525–1 | Eastern State Penitentiary | F. L. Bollinger | 1928 | 255 | Drl | 10 | 489 | 10 | TRb | 7–23–63 | 234 | 155 | PS | |
| 535 | 013–525–1 | do. | do. | 1929 | 280 | Drl | 10 | 552 | 21 | TRb | 7–23–63 | 248 | 135 | PS | 11.5 ft. dd. in 73 hrs. |
| 536 | 013–525–3 | do. | do. | 1929 | 280 | Drl | 10 | 497 | 32 | TRb | 5– ?–62 | 245 | 116 | PS | 11 ft. dd. in 73 hrs. |
| 537 | 013–526–2 | do. | do. | 1929 | 280 | Drl | 10 | 596 | 20 | TRb | 7–23–63 | 260 | 98 | PS | 12 ft. dd. in 24 hrs. |
| 538 | 014–525–2 | do. | do. | 1937 | 305 | Drl | 12 | 512 | 19 | TRb | 8– ?–60 | 204 | 355 | PS | 87 ft. dd. in 72 hrs. |
| 539 | 014–525–3 | do. | Artesian Well Drilling | 1951 | 285 | Drl | 16–8 | 502 | 24 | TRb | 7–23–60 | 195 | 300 | PS | 18 ft. dd. in 48 hrs. |
| 540 | 013–526–3 | do. | F. L. Bollinger | 1951 | 270 | Drl | 10 | 600 | | TRb | 4– 9–62 | 180 | 90 | PS | CA |
| 541 | 010–530–1 | Charles Johnson Home | do. | 1959 | 150 | Drl | 12–8 | 300 | 44 | TRb | 6– 9–60 | 15 | 135 | PS | CA |
| 542 | 010–530–2 | do. | | 1930 | 240 | Drl | 8 | 198 | | TRb | | | 84 | PS | FA |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 543 | 010-532-1 | Diamond Glass Co. | Ridpath & Potter | 1956 | 110 | Drl | 16-10 | 400 | 60 | Trb | 8-10-56 | 20 | 191 | I | FA; 125 ft. dd. in 24 hrs. |
| 544 | 010-532-2 | Spring Ford Foundry & Machine Co. | | | 115 | Drl | | 120 | | Trb | | | | I | FA |
| 545 | 010-532-3 | Bush Bros. | C. S. Garber | 1947 | 115 | Drl | 10 | 223 | | Trb | | | 60+ | I | FA |
| 546 | 011-532-1 | Potts Bros. | do. | 1959 | 227 | Drl | 6 | 172 | 42 | Trb | 5- ?-59 | 37 | 40 | I | |
| 547 | 010-532-4 | Royersford Foundry & Machine Co. | | | 120 | Drl | 6 | 100+ | | Trb | | | | I | |
| 548 | 010-532-5 | Bankers Bar | C. S. Garber | 1959 | 160 | Drl | 6 | 201 | 50 | Trb | | | 60 | D | FA |
| 549 | 011-531-1 | Nelsons Ice Cream Inc. | Kohl Bros. | 1925 | 175 | Drl | 8 | 225 | | Trb | | | 60+ | I | FA |
| 550 | 011-532-2 | Cann & Saul Steel Co. | do. | 1941 | 187 | Drl | 6 | 235 | 21 | Trb | 6- 8-60 | 11 | 30 | O | EL, H |
| 551 | 012-522-1 | O. J. Hynes | | | 265 | Drl | 8 | 450 | | Trb | 3-30-60 | 63 | | I | CA |
| 552 | 012-525-1 | John Nast | A. W. Dorn | 1957 | 260 | Drl | 6 | 90 | | Trb | 3-30-60 | 21 | | D | FA |
| 553 | 012-525-2 | Natalie Schmitt | | 1959 | 260 | Drl | 6 | 102 | 38 | Trb | | | 25 | D | FA |
| 554 | 012-525-3 | McCormic Air Services | Miller Pump Servic | 1959 | 285 | Drl | 6 | 154 | 40 | Trb | 3-30-60 | 50 | 40 | D | FA |
| 555 | 012-532-1 | S. A. Wetty & Sons | C. S. Garber | 1949 | 260 | Drl | 6 | 160 | 12 | Trb | 6- 9-60 | 72 | | I | FA |
| 556 | 012-532-2 | do. | do. | 1956 | 260 | Drl | 6 | 190 | 21 | Trb | 8-20-56 | 69 | 15 | I | |
| 557 | 012-534-1 | Kinsey Distilling Corp. | do. | 1934 | 150 | Drl | 10 | 394 | | Trb | | | 95 | I | CA |
| 558 | 012-534-2 | do. | do. | 1934 | 150 | Drl | 10 | 360 | | Trb | | | 225 | I | |
| 559 | 012-534-3 | do. | do. | 1934 | 155 | Drl | 10 | 328 | | Trb | | | 107 | I | |
| 560 | 012-534-4 | do. | do. | 1934 | 170 | Drl | 10 | 145 | | Trb | | | 10 | I | |
| 561 | 012-534-5 | do. | do. | 1935 | 115 | Drl | 6 | 179 | | Trb | | | 55 | I | |
| 562 | 012-534-6 | do. | do. | 1934 | 145 | Drl | 10 | 365 | | Trb | | | 213 | I | |
| 564 | 012-534-8 | Sanitary Company of America | | | 125 | Drl | | 200+ | | Trb | | | | I | |
| 565 | 012-534-9 | do. | Wallace Reigner | 1959 | 127 | Drl | 6 | 98 | | Trb | | | | D | |
| 566 | 013-518-5 | Martin Century Farms | F. L. Bollinger | 1960 | 280 | Drl | 14-10 | 330 | 45 | Trb | 3-17-60 | 15 | 226 | I | 152 ft. dd. in 21 hrs. |
| 567 | 013-521-1 | C. V. Hollis | | 1943 | 267 | Drl | 6 | 135 | 50 | Trb | | | | D | FA |
| 568 | 013-521-2 | C. W. Bosler | | 1940 | 255 | Drl | 6 | 110 | 50 | Trb | | | | D | FA |
| 569 | 013-521-3 | do. | | | 255 | Drl | 6 | 79 | 25 | Trb | 3-31-60 | 23 | | U | FA |
| 570 | 013-521-4 | Fischers Pool & Cottages | Patrick Flaherty | 1948 | 195 | Drl | 8 | 195 | 25 | Trb | | 7 | 48 | PS | |
| 571 | 013-521-5 | do. | do. | | 181 | Drl | 6 | 90 | 25 | Trb | | | 20 | PS | |
| 572 | 013-521-6 | do. | do. | | 176 | Drl | 6 | 78 | 25 | Trb | | | 20 | PS | |
| 573 | 013-521-7 | do. | do. | 1935 | 178 | Drl | 6 | 90 | 25 | Trb | | | 20 | D | FA |
| 574 | 013-524-1 | John Gregory | | | 270 | Dug | | 19 | | Trb | 3-30-60 | 8 | | D | FA |
| 575 | 013-524-2 | Anna Lewandowski | Parente Bros. | 1940 | 210 | Drl | 6 | 140 | | Trb | | | | D | FA |
| 576 | 013-536-1 | Firestone Tire & Rubber Co. | C. S. Garber | 1947 | 152 | Drl | 14-10 | 351 | 38 | Trb | | | 180 | I | |
| 577 | 013-536-2 | do. | do. | 1942 | 153 | Drl | 14-10 | 402 | 35 | Trb | | | 193 | I | |
| 578 | 013-536-3 | do. | do. | 1947 | 152 | Drl | 14-10 | 342 | 35 | Trb | | | 73 | I | |
| 579 | 013-536-4 | do. | do. | 1942 | 147 | Drl | 14-10 | 494 | 75 | Trb | 9-22-61 | 52 | 61 | I | EL |
| 580 | 013-536-5 | do. | do. | 1942 | 136 | Drl | 14-10 | 276 | 36 | Trb | | | 153 | I | |
| 581 | 013-536-6 | do. | do. | 1942 | 190 | Drl | 14-10 | 394 | 32 | Trb, Trl | 6- 1-60 | 79 | 62 | U | EL, H, FA |
| 582 | 013-536-7 | do. | do. | 1947 | 130 | Drl | 14-10 | 371 | 37 | Trb | | | 94 | I | |
| 583 | 013-536-8 | do. | do. | 1942 | 165 | Drl | 14-10 | 355 | 47 | Trb | | | 170 | I | |
| 584 | 014-536-1 | do. | do. | 1942 | 186 | Drl | 14-10 | 406 | 42 | Trb | | | 108 | I | |
| 585 | 014-536-2 | do. | do. | 1942 | 157 | Drl | 14-10 | 266 | 50 | Trb | | | 70 | I | |
| 588 | 014-515-1 | Picolet Dye Works Inc. | Walter Emert | | 430 | Drl | 6 | | | Trb, Trl | 6-23-60 | 36 | | U | |
| 589 | 014-515-2 | do. | do. | 1951 | 430 | Drl | 6 | 820 | | Trb, Trl | | | 4 | I | |
| 590 | 014-515-3 | do. | William Stothoff | | 430 | Drl | | 300 | | Trb, Trl | | | 20 | I | |
| 591 | 014-515-4 | do. | Walter Emert | | 425 | Drl | 6 | 400 | | Trb, Trl | | | 12 | I | FA |
| 592 | 014-516-7 | Lansdale Borough | | | 390 | Drl | 12-8 | 235 | 44 | Trb, Trl | 5-26-59 | 87 | 67 | PS | 67 ft. dd. in 24 hrs. |
| 593 | 014-518-3 | Lansdale Municipal Authority | Kohl Bros. | 1958 | 320 | Drl | 12-8 | 492 | 76 | Trb | 9- ?-59 | 111 | 200 | PS | 190 ft. dd. in 48 hrs. |
| 594 | 014-520-1 | H. H. Becker | | 1925 | 185 | Drl | 6 | | | Trb | 4-18-60 | 23 | | PS | |
| 595 | 014-520-2 | Pa. Turnpike Lansdale Interchange | Thomas G. Keyes | 1955 | 265 | Drl | 10 | 135 | 42 | Trb | 4-27-60 | 32 | 17 | D | FA |
| 596 | 014-525-1 | Robert Aldefer | Parente Bros. | 1943 | 275 | Drl | 6 | 210 | 30 | Trb | 1957 | 152 | 30 | D | 8 ft. dd. in 2 hrs. |
| 597 | 014-533-1 | Pottstown Airport | C. S. Gaber | 1958 | 310 | Drl | 6 | 220 | 40 | Trb | | 90 | 12 | D | |
| 598 | 014-536-3 | Sunnybrook Enterprises | do. | 1954 | 150 | Drl | 8 | 262 | 46 | Trb | 4- 3-62 | 8 | 90 | PS | FA |

## Table 6. Record of wells—Continued

| Well number | Location number | Owner | Driller | Date completed | Altitude above sea level (feet) | Method of construction | Diameter of casing (inches) | Total depth (feet) | Depth to bottom of casing (feet) | Aquifer name | Static water level: Date measured | Static water level: Depth below land surface (feet) | Yield (gpm) | Use | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mg 599 | 014-537-1 | Dana Corp. | | | 155 | Drl | 8 | 385 | | TRb | | | 160 | I | |
| 600 | 014-537-2 | do. | | | 155 | Drl | 10 | 287 | | TRb | | | 130+ | I | |
| 601 | 014-537-3 | do. | Joseph Smith | 1941 | 160 | Drl | 8 | 540 | | TRb | 1- 7-42 | 30 | 125 | I | FA |
| 602 | 014-537-4 | do. | do. | 1941 | 150 | Drl | 8 | 425 | | TRb | | | 90 | I | |
| 603 | 014-537-5 | do. | Kohl Bros. | 1942 | 150 | Drl | 6 | 916 | 850 | TRb | | | 150 | I | CA |
| 604 | 014-538-1 | Bethlehem Steel Co. | | 1916 | 145 | Drl | 8 | 200 | | TRb | | 25 | 200 | I | |
| 605 | 014-538-2 | do. | | 1916 | 145 | Drl | 8 | 200 | | TRb | | 25 | 200 | I | |
| 606 | 014-538-3 | Levengood Dairy | | 1917 | 165 | Drl | | | | TRb | | | | I | |
| 607 | 014-538-4 | do. | Joseph Smith | 1932 | 165 | Drl | 8 | 184 | | TRb | | | 150 | I | FA |
| 608 | 014-540-3 | Stanley G. Flagg Inc. | | 1910 | 150 | Drl | | 201 | | TRb | 1958 | 100 | 120 | I | |
| 609 | 014-540-1 | do. | Kohl Bros. | 1945 | 145 | Drl | 8 | 200 | 35 | TRb | 1958 | 63 | 147 | I | |
| 610 | 014-540-2 | do. | do. | 1947 | 145 | Drl | 8 | 244 | 82 | TRb | 1958 | 86 | 200 | I | 67 ft. dd. in 2 hrs. |
| 611 | 014-540-4 | do. | do. | 1948 | 145 | Drl | 8 | 350 | 36 | TRb | 1958 | 96 | 255 | U | |
| 612 | 015-514-1 | Lock Seam Tube Inc. | | | 455 | Drl | | | | TRb | | | | D | FA |
| 613 | 015-515-1 | Picolet Dye Works Inc. | Walter Emert | | 370 | Drl | 6 | 320 | | TRb | | | 15 | I | |
| 614 | 015-515-2 | do. | do. | | 375 | Drl | 6 | 120 | | TRb | | | 10 | I | |
| 616 | 013-522-1 | Eugene D. Rutter | | | 180 | Drl | 6 | 100 | | TRb | | | 25 | I | CA |
| 618 | 015-516-4 | Penndale Inc. | R. L. Knieriem | 1958 | 360 | Drl | | 330 | | TRb | | | 30 | I | |
| 619 | 015-516-5 | American Encaustic Tile Co. | | | 335 | Drl | | 88 | | TRb | 6-8 -56 | 74 | | U | |
| 620 | 015-516-6 | do. | William Stothoff | 1955 | 360 | Drl | 10 | 400 | 116 | TRb | 3-28-58 | 94 | 100+ | I | |
| 621 | 015-516-7 | do. | do. | 1957 | 335 | Drl | 10 | 400 | | TRb | 1957 | 58 | | I | |
| 622 | 015-516-8 | A. M. Kulp School | Miller Pump Service | 1956 | 297 | Drl | 8-6 | 600 | 100 | TRb | 10- 9-57 | 24 | 55 | PS | FA; 50 ft. dd. in 24 hrs. |
| 623 | 015-517-9 | Lansdale Municipal Authority | William Stothoff | 1957 | 330 | Drl | 10 | 507 | 97 | TRb | 12-18-62 | 41 | 200 | U | EL |
| 624 | 015-517-13 | J. W. Rex Inc. | F. L. Bollinger | 1958 | 315 | Drl | 8 | 504 | 85 | TRb | 1958 | 105 | 9 | U | |
| 625 | 015-517-14 | do. | do. | 1958 | 320 | Drl | 8 | 384 | 62 | TRb | 4- ?-60 | 54 | 186 | I | |
| 627 | 015-519-1 | Paul Clemens | | | 345 | Drl | 6 | 125 | | TRb | 4- 1-60 | 30 | | D | FA |
| 628 | 015-519-2 | M. L. Dickinson | | | 320 | Drl | 6 | 84 | | TRb | 4- 1-60 | 49 | | D | FA |
| 629 | 015-520-1 | Christopher Dock Mennonite H. S. | | | 300 | Drl | 6 | 101 | | TRb | 3-31-60 | 54 | | PS | |
| 630 | 015-520-2 | do. | A. W. Dorn | 1959 | 300 | Drl | 8 | 130 | | TRb | 8-10-59 | 52 | 60 | PS | FA |
| 631 | 015-520-3 | Nice Ball Bearing Co. | Ridpath & Potter | 1959 | 285 | Drl | 10 | 500 | 60 | TRb | 3-29-60 | 55 | 200 | I | CA |
| 632 | 015-520-11 | U. S. Geol. Survey | C. S. Garber | 1960 | 285 | Drl | 6 | 500 | 31 | TRb | 8-29-63 | 71 | | T | EL, H, SL |
| 633 | 015-520-10 | do. | C. S. Garber & Kohl Bros. | 1962 | 270 | Drl | 6 | 500 | 32 | TRb | 8-29-63 | 62 | 125 | T | EL, H, SL |
| 634 | 015-520-4 | Elwell Davies | | | 310 | Drl | 8 | 198 | | TRb | 4- 4-60 | 55 | | D | FA |
| 635 | 015-520-5 | John Felver | | | 300 | Drl | 6 | 167 | | TRb | | | | D | FA |
| 636 | 015-520-6 | William Delp | | | 257 | Drl | 6 | 87 | | TRb | 4- 1-60 | 49 | | D | FA |
| 637 | 015-520-7 | Abram Ziegler | Miller Pump Service | 1930 | 220 | Drl | 8 | 105 | | TRb | 4- 1-60 | 22 | | D | FA |
| 638 | 015-520-8 | Frank Wambold | Patrick Flaherty | 1958 | 235 | Drl | 8 | 100 | 16 | TRb | | | 40+ | D | FA |
| 639 | 015-520-9 | William Delp | | | 240 | Dug | | 35 | | TRb | | | | D | FA |
| 640 | 015-528-1 | Schwenksville Water Co. | F. L. Bollinger | 1940 | 238 | Drl | 8 | 503 | | TRb | 1960 | 135 | 80 | PS | |
| 641 | 015-528-2 | do. | | | 260 | Drl | 6 | 213 | | TRb | | | | U | |
| 642 | 015-528-3 | do. | F. L. Bollinger | | 250 | Drl | 8 | 312 | | TRb | 1960 | 120 | 70 | PS | CA |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 643 | 016–517–1 | Girard Knitting Mills | | | 330 | Drl | 6 | | | Trb | | | | D | |
| 644 | 016–517–4 | Hatfield Borough | William Stothoff | 1957 | 330 | Drl | 10 | 400–500 | | Trb | | | 160 | PS | |
| 645 | 016–522–1 | Alderfer Bologna Co. | A. W. Dorn | 1959 | 280 | Drl | | 206 | 27 | Trb | 7–15–59 | 36 | 70 | I | FA |
| 646 | 016–523–1 | Harleysville Insurance Co. | | 1949 | 335 | Drl | | | | Trb | | | | I | FA |
| 647 | 016–523–2 | Lower Salford Twp. School | | 1912 | 280 | Drl | 6 | 160 | | Trb | | | | PS | |
| 648 | 016–523–3 | do. | | 1936 | 280 | Drl | 6 | 200 | | Trb | | | 5 | PS | FA |
| 649 | 017–517–1 | Hunter Spring Co. | Kohl Bros. | 1960 | 370 | Drl | 10 | 400 | 42 | Trb, Trl | 2– ?–60 | 8 | 105 | I | EL; 100 ft. dd. in 16 hrs. |
| 650 | 017–518–1 | Walter Forest | A. W. Dorn | 1945 | 345 | Drl | | 75 | | Trb | | | 16 | PS | FA |
| 651 | 017–518–2 | do. | do. | 1957 | 345 | Drl | | 170 | | Trb | | | 25 | PS | |
| 652 | 017–518–3 | Schlosser Steel Inc. | | 1958 | 370 | Drl | | 87 | | Trb | | | | I | |
| 653 | 017–518–4 | A. Steiert & Son Inc. | | 1937 | 390 | Drl | 10 | 205 | 30 | Trl | | 25 | | I | |
| 654 | 017–519–1 | Souderton Borough | F. L. Bollinger | 1956 | 380 | Drl | | 300 | | Trl | | | 10 | U | |
| 655 | 017–520–1 | do. | | | 375 | Drl | | 300 | | Trl | | | 10 | U | |
| 656 | 017–524–1 | NYCE Manufacturing Co. | Parente Bros. | 1925 | 300 | Drl | 6 | | | Trb, Trl | 5–24–60 | 9 | | I | FA |
| 658 | 018–518–1 | R. T. French Co. | F. L. Bollinger | 1956 | 390 | Drl | 8 | 400 | 40 | Trb | | | 100 | I | |
| 659 | 018–518–2 | Souderton Borough | | 1915 | 525 | Drl | | 600–700 | | Trl | | | | U | |
| 660 | 018–518–4 | do. | | 1929 | 455 | Drl | 10 | 300 | 13 | Trb | 12– ?–53 | 39 | 45 | PS | |
| 662 | 018–519–1 | do. | F. L. Bollinger | 1948 | 320 | Drl | | 300 | | Trb | 5– ?–60 | 75 | 50 | PS | CA |
| 663 | 018–519–2 | do. | William Stothoff | 1958 | 340 | Drl | 8 | 300 | 40 | Trb | 4– ?–59 | 16 | 110 | PS | |
| 664 | 018–519–3 | do. | | 1957 | 340 | Drl | 10 | 400 | 30 | Trb | | | 45 | PS | |
| 665 | 018–519–4 | do. | F. L. Bollinger | 1954 | 360 | Drl | 12 | 300 | 21 | Trb | | | 80 | PS | |
| 666 | 018–519–5 | Souderton Steam Laundry | | 1929 | 390 | Drl | 8 | 88 | | Trb | | | 30 | I | |
| 667 | 018–519–6 | Eastern Mennonite Home | J. W. Shaw | 1917 | 460 | Drl | 6 | 192 | | Trb, Trl | 5–23–60 | 111 | 10 | PS | FA |
| 668 | 018–519–7 | Granite Hosiery Mills | | | 390 | Drl | 8–6 | 208 | | Trb | 6–14–57 | 65 | 11 | I | FA |
| 669 | 018–519–8 | Souderton Borough | | | 395 | Drl | 8 | 112 | 20 | Trb | 1952 | 48 | 50 | U | |
| 670 | 018–519–9 | do. | | 1936 | 410 | Drl | 12 | 205 | 25 | Trb | 5– ?–60 | 125 | 80 | PS | |
| 671 | 018–519–10 | do. | | 1911 | 410 | Drl | 8 | 224 | 120 | Trb | 1–16–61 | 54 | 80 | U | EL |
| 672 | 018–519–11 | do. | | | 395 | Drl | | 600–700 | | Trb | | | 15 | U | |
| 673 | 018–519–12 | Souderton Borough | | | 415 | Drl | 6 | 300–350 | | Trb | | | | X | |
| 674 | 018–519–13 | M. B. Bergey Hosiery Mill | | | 390 | Drl | 6 | 92 | | Trb | | | | U | |
| 675 | 018–519–14 | Goodman Silk Mill | | | 500 | Drl | 6 | 750 | | Trb, Trl | | | | U | |
| 676 | 018–519–15 | H. S. Souder | | | 390 | Drl | 6 | 90 | | Trb | | | | U | |
| 677 | 018–519–16 | Henry L. Landis Estate | | | 480 | Drl | 6 | 300 | | Trb | | | | I | |
| 678 | 026–532–1 | East Greenville Borough | F. L. Bollinger | 1959 | 315 | Drl | 14–10 | 300 | 60 | Trb | 6–20–59 | 14 | 240 | PS | CA; 94 ft. dd. in 72 hrs. |
| 679 | 018–519–17 | Souderton Borough | William Stothoff | 1960 | 360 | Drl | 12–8 | 308 | 43 | Trb | 2–15–61 | 12 | 250 | O | EL, H, SL; 71 ft. dd. in 49 hrs |
| 680 | 018–532–1 | New Hanover Twp. School | | 1952 | 365 | Drl | | 500 | | Trb | | | | PS | CA |
| 681 | 018–521–1 | Franconia Twp. School | Parente Bros. | 1939 | 475 | Drl | 6 | 280 | | Trb | | | | PS | FA |
| 682 | 018–531–1 | Mennonite Home for the Aged | | | 325 | Drl | 6 | 60 | | Trb | | | | PS | |
| 683 | 018–531–2 | do. | Mayer | 1956 | 325 | Drl | 8 | 175 | | Trb | | | | PS | |
| 684 | 019–519–1 | Telford Borough | Ridpath & Potter | | 420 | Drl | 10 | 240 | | Trb | | | 190 | PS | |
| 686 | 019–519–5 | Souderton Borough | | | 450 | Drl | | 600 | | Trb | | | 12 | U | |
| 687 | 019–537–1 | Fashion Hosiery Mills Inc. | Kohl Bros. | 1948 | 340 | Drl | 6 | 400 | 50 | Trb | 6– ?–48 | 8 | 150 | I | FA |
| 688 | 019–537–2 | do. | do. | 1948 | 340 | Drl | 8 | 600 | 10 | Trb | 5– ?–48 | 7 | 60 | R | 143 ft. dd. in 1 hr. |
| 689 | 020–528–1 | Maranatha Park | Campbell | | 320 | Drl | | 300 | | Trb | | | 20 | PS | CA |
| 690 | 020–528–2 | do. | do. | 1950 | 325 | Drl | | 310 | | Trb | | 100 | | PS | |
| 691 | 013–516–5 | R. D. Gillen | V. D. Kohler | 1960 | 355 | Drl | 6 | 171 | | Trb | | | | D | |
| 692 | 018–522–1 | Keller's Creamery | Joseph Mayer | 1960 | 300 | Drl | | 150 | | Trb | | | | D | |
| 693 | 018–522–2 | do. | A. W. Dorn | 1950 | 300 | Drl | | 150 | | Trb | | | | I | |
| 695 | 016–517–5 | Dorsey Shultz | | | 340 | Drl | 6 | 55 | | Trb | 6–13–61 | 10 | | D | FA |
| 696 | 017–523–1 | Harvey Koffel | | 1941 | 240 | Drl | 6 | 78 | | Trb | 6–15–61 | 16 | | D | FA |
| 697 | 012–522–2 | Gordon Wilkie | Miller Pump Service | 1956 | 230 | Drl | 6 | 85 | 43 | Trb | 6–14–61 | 18 | | D | FA |
| 698 | 015–521–1 | Earl Ehrhart | Charles Lauman | | 200 | Drl | 6 | 80 | | Trb | 6–14–61 | 23 | | D | |
| 699 | 020–522–1 | R. L. Koehler | A. W. Dorn | 1946 | 480 | Drl | 6 | 81 | | Trb | 6–12–61 | 28 | | D | FA |
| 700 | 014–540–5 | Stanley G. Flagg Inc. | Kohl Bros. | 1961 | 145 | Drl | 8 | 650 | 88 | Trb | 11–20–61 | 22 | 75 | I | EL, SL; 200 ft. dd. in 40 min. |

## Table 6. Record of wells—Continued

| Well number | Location number | Owner | Driller | Date completed | Altitude above sea level (feet) | Method of construction | Diameter of casing (inches) | Total depth (feet) | Depth to bottom of casing (feet) | Aquifer name | Static water level: Date measured | Static water level: Depth below land surface (feet) | Yield (gpm) | Use | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mg 701 | 020–536–1 | Kawecki Chemical Co. | Kohl. Bros. | 1957 | 320 | Drl | 6 | 405 | 19 | TRb | 1957 | 20 | 150 | I | 180 ft. dd. in 40 hrs. |
| 702 | 020–536–5 | do. | C. S. Garber | 1961 | 310 | Drl | 6 | 300 | 60 | TRb | 11– 7–61 | 8 | 100 | I | EL |
| 703 | 020–536–6 | do. | do. | 1961 | 315 | Drl | 6 | 400 | 30 | TRb | 11– 7–61 | 36 | 40 | U | EL |
| 704 | 015–517–15 | Lansdale Municipal Authority | F. L. Bollinger | 1962 | 310 | Drl | 14–10 | 400 | 80 | TRb | 12– 4–61 | 25 | 135 | PS | EL, SL; 135 ft. dd. in 40 hrs. |
| 705 | 024–528–1 | Upper Hanover Twp. | C. S. Garber | 1957 | 480 | Drl | 6 | 275 | 21 | TRb | 5– 4–57 | Flows | 100 | D | |
| 708 | 022–534–1 | H. J. Beitler | Hunsicker | 1943 | 495 | Drl | 6 | 123 | 14 | TRb | 1955 | 80 | 24+ | D | CA |
| 709 | 018–523–1 | S. P. Godshall | Stover | | 330 | Drl | 6 | 80 | | TRb | 2– 8–62 | 51 | | D | CA |
| 710 | 018–527–1 | Frank Seal | C. S. Garber | 1950 | 430 | Drl | 6 | 100+ | | TRb | 2– 8–62 | 18 | | D | CA |
| 711 | 023–527–1 | A. T. Goadby | W. W. Wonsidler | 1957 | 480 | Drl | 6 | 81 | 30 | TRb | 10– ?–57 | 12 | 20 | D | CA |
| 712 | 017–535–1 | E. F. Barndt | C. S. Garber | 1940 | 260 | Drl | 6 | 157 | 40 | TRb | 2– 5–62 | 7 | 10 | D | CA |
| 713 | 013–514–1 | N. T. Cummings | Miller Pump Service | 1956 | 450 | Drl | 6 | 312 | 40 | TRl | 1956 | 80 | 7 | D | CA |
| 714 | 014–538–22 | Ferro-Phos Co. | | | 175 | Drl | 6 | 138 | | TRb | | 40 | | I | FA |
| 715 | 015–524–1 | Stanley Slemmer | | 1951 | 300 | Drl | 6 | 140 | 30 | TRl | 1951 | 25 | 20 | D | CA |
| 716 | 010–523–1 | Florence A. Plummer | Charles Lauman | 1937 | 410 | Drl | 6 | 200 | | TRl | | | 40 | D | CA |
| 717 | 010–523–2 | do. | | 1927 | 410 | Drl | 8 | 280 | | TRl | | | | D | |
| 718 | 013–531–1 | Fred Tyson | Tenney | 1950 | 295 | Drl | 6 | 133 | | TRb | 4– 9–62 | 21 | 10 | D | CA |
| 720 | 011–530–2 | Bechtel's Dairy | Kohl Bros. | 1955 | 230 | Drl | 6 | 300 | 38 | TRb | 6– ?–55 | 53 | 70 | I | |
| 721 | 011–530–1 | do. | do. | 1944 | 200 | Drl | 8 | 325 | 15 | TRb | 10– ?–44 | 60 | 40 | I | |
| 723 | 018–521–3 | H. W. Longacre | A. W. Dorn | 1958 | 395 | Drl | 8 | 328 | 29 | TRb | 10–13–58 | 76 | 80 | I | FA |
| 724 | 018–521–4 | do. | | | 395 | Drl | 6 | | | TRb | | | | I | |
| 725 | 015–527–1 | Schwenksville Water Co. | F. L. Bollinger | 1962 | 145 | Drl | 8 | 300 | 30 | TRb | 7–30–62 | 14 | 250 | PS | EL, SL |
| 726 | 014–536–4 | American Telephone & Telegraph Co. | C. S. Garber | 1961 | 185 | Drl | 6 | 300 | 52 | TRb | | 56 | 37 | I | 154 ft. dd. in 8 hrs. |
| 727 | 014–536–5 | do. | do. | 1961 | 185 | Drl | 6 | 300 | | TRb | | | 30 | I | |
| 728 | 020–536–8 | Kawecki Chemical Co. | do. | 1961 | 320 | Drl | 6 | 360 | 21 | TRb | 1961 | 140 | 90+ | D | |
| 729 | 023–530–1 | Perkiomen School | | 1907 | 340 | Drl | 6 | 1000 | | TRb | 7–24–62 | Flows | 20 | U | |
| 730 | 020–536–9 | Kawecki Chemical Co. | | | 315 | Drl | 6 | 125 | 14 | TRb | 9–25–62 | 4 | | X | EL |
| 731 | 017–517–2 | Hunter Spring Co. | Thomas G. Keyes | 1962 | 360 | Drl | 8 | 400 | 22 | TRb, TRl | 1962 | 6 | 110 | I | EL; 191 ft. dd. in 24 hrs. |
| 732 | 017–517–3 | do. | do. | 1962 | 360 | Drl | 8 | 403 | | TRb | 1962 | 0 | 7 | U | EL |
| 733 | 020–525–1 | E. E. Endy | Joseph Mayer | | 420 | Drl | 6 | 42 | | TRd | 8– 6–63 | 18 | 2 | U | 18 ft. dd. in 3 hrs. |
| 734 | 020–526–1 | Delmont Scout Reservation | | | 275 | Drl | 6 | 125 | | TRd | 8– 9–63 | 14 | 20 | PS | 26 ft. dd. in 2 hrs. |
| 735 | 020–526–2 | do. | | | 275 | Drl | 6 | 45 | | TRd | 8– 9–63 | 14 | | D | |
| 736 | 011–526–5 | Linwood Yost | | | 115 | Drl | 6 | 111 | | TRb | | 50 | 4 | D | CA |
| 737 | 014–514–3 | John Wright | | | 445 | Drl | 6 | 80 | | TRl | | 11 | 15 | D | CA |
| 738 | 013–531–2 | Limerick School | | | 305 | Drl | 6 | 110 | | TRb | | 30 | 15 | D | CA |
| 739 | 009–524–1 | Eagleville Sanatorium | | | 425 | Drl | 6 | 511 | | TRl | | | 9 | U | CA |
| 740 | 019–529–1 | Upper Perkiomen Valley Park | F. L. Bollinger | 1960 | 320 | Drl | 6 | 415 | | TRd | 9– 5–63 | 35 | 20 | PS | 114 ft. dd. in 1 hr. |
| 741 | 020–529–1 | do. | do. | 1947 | 230 | Drl | 6 | 359 | | TRd | 8–23–63 | 30 | 50 | PS | 151 ft. dd. in 2 hrs. |
| 742 | 020–529–2 | do. | do. | 1940 | 290 | Drl | 6 | 250 | | TRd | | | 13 | PS | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 743 | 012-527-1 | Techalloy Co. | C. S. Garber | 1961 | 210 | Drl | 6 | 235 | 42 | TRb | 12-[illegible]-61 | 65 | 30 | I | |
| 744 | 019-530-1 | R. B. Brooks | | | 305 | Drl | 6 | 65 | 40 | TRd | 8-22-63 | 31 | 5 | D | 4 ft. dd. in 3 hrs. |
| 745 | 020-530-1 | M. H. Gulack | | | 340 | Drl | 6 | 68 | | TRd | 8-22-63 | 25 | 3 | D | 6 ft. dd. in 3 hrs. |
| 746 | 018-528-1 | J. L. Beck | | | 250 | Drl | 6 | 38 | | TRd | 8-16-63 | 13 | 3 | D | 1.4 ft. dd. in 2 hrs. |
| 747 | 020-533-1 | Ralph Levitz | | | 350 | Drl | 6 | 132 | | TRd | 8-30-63 | 3 | 3 | D | 3 ft. dd. in 3 hrs. |
| 748 | 020-532-1 | Joseph Kulp | | 1963 | 420 | Drl | 6 | 110 | | TRd | 8-28-63 | 17 | 0.3 | D | |
| 749 | 020-532-2 | do. | | 1963 | 420 | Drl | 6 | 42 | | TRd | 8-28-63 | 16 | | U | |
| 753 | 016-527-1 | John Lesher | Michael Kuszyk | 1963 | 190 | Drl | 6 | 313 | 20 | TRd | 8-19-63 | 14 | 0.1 | D | |
| 754 | 017-515-1 | Atlantic Refining Co. | Philadelphia Drilling Co. | 1952 | 275 | Drl | 6 | 106 | 35 | TRb | 3-25-53 | 5 | 20 | D | |
| 755 | 014-540-6 | Stanley G. Flagg Inc. | Kohl Bros. | 1963 | 150 | Drl | 10 | 595 | 47 | TRb | 6-13-63 | 30 | 430 | I | 150 ft. dd. in 18 hrs. |

## Table 7. Sample logs of wells in the Brunswick Formation in Berks and Montgomery Counties, Pa.

Well Be-125

Owner: U.S. Geological Survey

| Description | Depth (feet) |
|---|---|
| Soil, red | 0 — 2 |
| Shale, red | 2 — 30 |
| Shale, red, moderately calcareous; calcite and quartz joint filling | 30 — 35 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 35 — 38 |
| Shale, red | 38 — 50 |
| Shale, red, moderately calcareous; calcite joint filling | 50 — 55 |
| Shale, red, moderately calcareous | 55 — 60 |
| Shale, red, moderately calcareous; calcite and quartz joint filling | 60 — 70 |
| Shale, red, slightly calcareous | 70 — 75 |
| Shale, red, slightly calcareous; quartz joint filling; goethite | 75 — 80 |
| Shale, red; calcite joint filling | 80 — 90 |
| Shale, red, slightly calcareous; calcite joint filling | 90 — 105 |
| Shale, red, moderately calcareous; calcite joint filling | 105 — 110 |
| Shale, purplish-gray, slightly calcareous | 110 — 115 |
| Shale, red; calcite joint filling | 115 — 120 |
| Shale, red, slightly calcareous; calcite joint filling | 120 — 125 |
| Shale, red, slightly calcareous | 125 — 130 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 130 — 135 |
| Shale, red, moderately calcareous; calcite joint filling | 135 — 140 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 140 — 145 |
| Shale, red, slightly calcareous; calcite joint filling | 145 — 150 |
| Siltstone, red, slightly calcareous | 150 — 155 |
| Shale, red, slightly calcareous; calcite and quartz joint filling; pyrite | 155 — 160 |
| Shale, red, slightly calcareous; calcite joint filling | 160 — 165 |
| Shale, red, moderately calcareous; calcite joint filling | 165 — 170 |
| Shale, red, slightly calcareous | 170 — 175 |
| Argillite, light gray, moderately calcareous; calcite joint filling; pyrite | 175 — 178 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 178 — 182 |
| Shale, red, slightly calcareous; calcite joint filling; pyrite | 182 — 185 |
| Shale, red, slightly calcareous; calcite joint filling | 185 — 190 |
| Shale, red, moderately calcareous; calcite joint filling; pyrite and goethite | 190 — 195 |
| Shale, red, slightly calcareous; calcite joint filling | 195 — 200 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 200 — 205 |
| Shale, red; calcite joint filling | 205 — 215 |
| Shale, red, slightly calcareous | 215 — 220 |
| Argillite, purple and a few streaks of brown and green; calcite and quartz joint filling; goethite | 220 — 225 |
| Shale, red, slightly calcareous; calcite joint filling | 225 — 227 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 227 — 230 |
| Shale, red, slightly calcareous; calcite joint filling | 230 — 240 |
| Shale, red, moderately calcareous; calcite joint filling | 240 — 243 |
| Shale, red, slightly calcareous; calcite joint filling | 243 — 265 |
| Shale, red, slightly calcareous; calcite joint filling pyrite and goethite | 265 — 273 |
| Shale, red, slightly calcareous; calcite joint filling | 273 — 280 |
| Shale, gray-brown, moderately calcareous; calcite joint filling; goethite | 280 — 282 |
| Argillite, blue-gray, moderately calcareous; calcite joint filling; goethite | 282 — 285 |
| Argillite, greenish-gray, moderately calcareous; calcite joint filling; goethite; very fine grained sandstone, yellow, moderately calcareous | 285 — 287 |

## Table 7. Sample logs of wells in the Brunswick Formation—Continued

Well Be-125—Continued

| | |
|---|---|
| Argillite, greenish-gray, moderately calcareous; calcite joint filling; pyrite | 287 — 288 |
| Argillite, purplish-brown; goethite | 288 — 290 |
| Shale, red, moderately calcareous; calcite joint filling | 290 — 292 |
| Shale, red, slightly calcareous; calcite joint filling | 292 — 294 |
| Shale, red | 294 — 296 |
| Shale, red, slightly calcareous; calcite joint filling | 296 — 300 |

Well Mg-632

Owner: U.S. Geological Survey

| Description | Depth (feet) |
|---|---|
| Soil, red | 0 — 2 |
| Shale, red, moderately calcareous; calcite joint filling | 2 — 5 |
| Shale, red, slightly calcareous | 5 — 10 |
| Shale, red, slightly calcareous; calcite joint filling | 10 — 15 |
| Shale, red, slightly calcareous | 15 — 18 |
| Shale, red, slightly calcareous; calcite joint filling | 18 — 25 |
| Shale, red, moderately calcareous; calcite joint filling | 25 — 30 |
| Shale, red, slightly calcareous; calcite joint filling | 30 — 40 |
| Shale, red, slightly calcareous | 40 — 45 |
| Shale, red, moderately calcareous; calcite joint filling | 45 — 52 |
| Shale, red, slightly calcareous; calcite joint filling | 52 — 85 |
| Shale, red, moderately calcareous; calcite joint filling | 85 — 90 |
| Shale, red, slightly calcareous, micaceous; calcite joint filling | 90 — 95 |
| Shale, red, slightly calcareous, micaceous; quartz and calcite joint filling | 95 — 100 |
| Shale, red, slightly calcareous, micaceous; calcite joint filling | 100 — 110 |
| Siltstone, red, moderately calcareous, micaceous; calcite and quartz joint filling | 110 — 120 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 120 — 125 |
| Shale, red, moderately calcareous, micaceous; calcite joint filling | 125 — 130 |
| Shale, red, moderately calcareous; calcite joint filling | 130 — 135 |
| Shale, red, moderately calcareous | 135 — 140 |
| Shale, red, slightly calcareous; calcite joint filling | 140 — 170 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 170 — 185 |
| Shale, red, moderately calcareous; calcite joint filling | 185 — 200 |
| Siltstone, red, slightly calcareous, micaceous; calcite joint filling | 200 — 210 |
| Shale, red, slightly calcareous, micaceous; quartz joint filling | 210 — 215 |
| Shale, red, slightly calcareous, micaceous; quartz and calcite joint filling | 215 — 220 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 220 — 225 |
| Shale, red, slightly calcareous; calcite joint filling | 225 — 235 |
| Shale, red, slightly calcareous | 235 — 240 |
| Shale, red; calcite joint filling | 240 — 250 |
| Shale, red; calcite and quartz joint filling | 250 — 260 |
| Shale, red, slightly calcareous; calcite joint filling | 260 — 290 |
| Shale, red, moderately calcareous | 290 — 300 |

## Table 7. Sample logs of wells in the Brunswick Formation—Continued

Well Mg-632—continued

| | |
|---|---|
| Shale, red, slightly calcareous | 300 — 310 |
| Shale, red, slightly calcareous; quartz and calcite joint filling | 310 — 315 |
| Siltstone, buff, moderately calcareous; red shale; quartz joint filling | 315 — 320 |
| Shale, red, slightly calcareous, micaceous; calcite joint filling | 320 — 325 |
| Shale, red, slightly calcareous, micaceous; calcite and quartz joint filling | 325 — 330 |
| Shale, red, slightly calcareous; calcite joint filling | 330 — 335 |
| Shale, red, micaceous; calcite and quartz joint filling | 335 — 340 |
| Shale, red moderately calcareous; calcite and quartz joint filling | 340 — 345 |
| Shale, red, moderately calcareous; calcite joint filling | 345 — 350 |
| Shale, red, slightly calcareous; calcite joint filling | 350 — 360 |
| Shale, red, micaceous; calcite and quartz joint filling | 360 — 363 |
| Shale, red, moderately calcareous; calcite joint filling | 363 — 370 |
| Shale, red, slightly calcareous | 370 — 375 |
| Shale, red, slightly calcareous; calcite joint filling | 375 — 379 |
| Shale, green, moderately calcareous | 379 — 381 |
| Shale, red, slightly calcareous; calcite joint filling | 381 — 385 |
| Shale, red, slightly calcareous | 385 — 405 |
| Shale, red, slightly calcareous; calcite joint filling | 405 — 425 |
| Shale, red, slightly calcareous | 425 — 450 |
| Shale, red, slightly calcareous; calcite joint filling | 450 — 460 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 460 — 465 |
| Shale, red, slightly calcareous | 465 — 470 |
| Shale, red, slightly calcareous; calcite joint filling | 470 — 475 |
| Shale, red, moderately calcareous; calcite joint filling | 475 — 480 |
| Shale, red, slightly calcareous | 480 — 490 |
| Shale, red, moderately calcareous; calcite joint filling | 490 — 500 |

Well Mg-633

Owner: U.S. Geological Survey

| Description | Depth (feet) |
|---|---|
| Shale, red; quartz joint filling | 0 — 5 |
| Shale, red, slightly calcareous, calcite joint filling | 5 — 20 |
| Shale, red, moderately calcareous; calcite joint filling | 20 — 25 |
| Shale, red, slightly calcareous; calcite joint filling | 25 — 30 |
| Shale, red, moderately calcareous | 30 — 35 |
| Shale, red, moderately calcareous; calcite joint filling | 35 — 40 |
| Shale, red; calcite joint filling | 40 — 45 |
| Shale, red, slightly calcareous; calcite joint filling | 45 — 55 |
| Shale, red, slightly calcareous; goethite | 55 — 60 |
| Shale, red, slightly calcareous; calcite joint filling | 60 — 70 |
| Shale, red, slightly calcaerous | 70 — 90 |
| Shale, red, moderately calcareous; calcite joint filling | 90 — 100 |
| Shale, red; calcite joint filling | 100 — 105 |
| Shale, red, slightly calcareous; abundant quartz and calcite joint filling. Quartz is in crystals up to half an inch long | 105 — 108 |
| Shale, red, slightly calcareous; calcite joint filling | 108 — 110 |
| Shale, red, slightly calcareous; abundant calcite joint filling | 110 — 112 |
| Shale, red, slightly calcareous; calcite and quartz joint filling and goethite | 112 — 115 |

## Table 7. Sample logs of wells in the Brunswick Formation—Continued

Well Mg-633—continued

| | |
|---|---|
| Shale, red; calcite joint filling | 115 — 118 |
| Shale, red | 118 — 120 |
| Shale, red, slightly calcareous | 120 — 123 |
| Shale, red | 123 — 125 |
| Shale, red, moderately calcareous; calcite joint filling | 125 — 128 |
| Shale, red, slightly calcareous | 128 — 138 |
| Shale, red, slightly calcareous; calcite joint filling | 138 — 140 |
| Shale, red, slightly calcareous | 140 — 142 |
| Shale, red, slightly calcareous; calcite joint filling | 142 — 148 |
| Shale, red, slightly calcareous | 148 — 150 |
| Shale, red, slightly calcareous; calcite joint filling and goethite | 150 — 152 |
| Shale, red, slightly calcareous; calcite joint filling | 152 — 165 |
| Shale, red, slightly calcareous | 165 — 168 |
| Shale, red, slightly calcareous; calcite joint filling | 168 — 170 |
| Shale, red; calcite joint filling | 170 — 172 |
| Shale, red | 172 — 175 |
| Shale, red, moderately calcareous | 175 — 178 |
| Shale, red, moderately calcareous; calcite joint filling | 178 — 185 |
| Shale, red; calcite joint filling | 185 — 205 |
| Shale, red, slightly calcareous; calcite joint filling | 205 — 210 |
| Shale, red; calcite joint filling | 210 — 212 |
| Shale, red, slightly calcareous; calcite joint filling | 212 — 215 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 215 — 220 |
| Shale, red, slightly calcareous; calcite joint filling | 220 — 225 |
| Shale, red; calcite joint filling | 225 — 230 |
| Shale, red: calcite and quartz joint filling and goethite | 230 — 232 |
| Shale, red, moderately calcareous; quartz and calcite joint filling | 232 — 233 |
| Shale, red; calcite joint filling | 233 — 235 |
| Shale, red, moderately calcareous; calcite joint filling | 235 — 237 |
| Shale, red; calcite joint filling | 237 — 240 |
| Shale, red, slightly calcareous; calcite joint filling | 240 — 243 |
| Shale, red, slightly calcareous | 243 — 245 |
| Shale, red; calcite joint filling | 245 — 263 |
| Shale, red, slightly calcareous; calcite joint filling | 263 — 270 |
| Shale, red | 270 — 275 |
| Shale, red, slightly calcareous; calcite joint filling | 275 — 278 |
| Siltstone, red, moderately calcareous; calcite joint filling | 278 — 280 |
| Shale, red, slightly calcareous; calcite joint filling | 280 — 283 |
| Shale, red; calcite joint filling | 283 — 288 |
| Shale, red, slightly calcareous; calcite joint filling | 288 — 290 |
| Shale, red, slightly calcareous | 290 — 295 |
| Shale, red; calcite joint filling | 295 — 300 |
| Shale, red | 300 — 302 |
| Shale, red; calcite joint filling | 302 — 307 |
| Shale, red, slightly calcareous; calcite joint filling | 307 — 310 |
| Shale, red, moderately calcareous; calcite joint filling | 310 — 312 |
| Shale, red, slightly calcareous | 312 — 314 |
| Shale, red, slightly calcareous; calcite joint filling | 314 — 325 |
| Shale, red, slightly calcareous; quartz joint filling | 325 — 327 |
| Shale, red, slightly calcareous | 327 — 330 |
| Shale, red | 330 — 335 |
| Shale, red; calcite joint filling | 335 — 348 |
| Shale, red, slightly calcareous; calcite joint filling | 348 — 350 |
| Shale, red, slightly calcareous | 350 — 355 |
| Shale, red, slightly calcareous; calcite joint filling | 355 — 358 |

## Table 7. Sample logs of wells in the Brunswick Formation—Continued

Well Mg-633—Continued

| | |
|---|---|
| Shale, red; calcite joint filling | 358 — 360 |
| Shale, red, moderately calcareous | 360 — 362 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 362 — 365 |
| Shale, red; calcite joint filling | 365 — 380 |
| Shale, red, moderately calcareous | 380 — 383 |
| Shale, red, moderately calcareous, micaceous | 383 — 385 |
| Shale, red, slightly calcareous; calcite joint filling | 385 — 390 |
| Shale, red, slightly calcareous | 390 — 392 |
| Shale, red | 392 — 395 |
| Shale, red, slightly calcareous | 395 — 402 |
| Shale, red, moderately calcareous; calcite joint filling | 402 — 405 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 405 — 408 |
| Shale, red, moderately calcareous | 408 — 410 |
| Shale, red, slightly calcareous | 410 — 412 |
| Shale, red, slightly calcareous; calcite joint filling | 412 — 415 |
| Shale, red, moderately calcareous; calcite joint filling | 415 — 417 |
| Shale, red, slightly calcareous; calcite joint filling, pyrite and goethite | 417 — 420 |
| Shale, red, slightly calcareous | 420 — 422 |
| Shale, red, slightly calcareous; calcite joint filling | 422 — 428 |
| Shale, red, slightly calcareous | 428 — 430 |
| Shale, red | 430 — 432 |
| Shale, red, slightly calcareous; calcite joint filling | 432 — 435 |
| Shale, red, moderately calcareous; calcite joint filling | 435 — 437 |
| Shale, red, slightly calcareous; calcite joint filling | 437 — 460 |
| Shale, red; calcite joint filling | 460 — 465 |
| Shale, red; calcite joint filling, pyrite and goethite | 465 — 467 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 467 — 470 |
| Shale, red, slightly calcareous | 470 — 473 |
| Shale, red, slightly calcareous; calcite joint filling | 473 — 497 |
| Shale, red | 497 — 500 |

Well Mg-679

Owner: Souderton Borough

| Description | Depth (feet) |
|---|---|
| Shale, red | 0 — 40 |
| Shale, red, moderately calcareous; calcite joint filling | 40 — 100 |
| Shale, dark reddish-gray, slightly calcareous | 100 — 110 |
| Shale, red, slightly calcareous; calcite joint filling and pyrite | 110 — 120 |
| Shale, red, slightly calcareous; calcite joint filling | 120 — 130 |
| Shale, dark red, moderately calcareous | 130 — 140 |
| Shale, red, slightly calcareous; calcite joint filling | 140 — 180 |
| Argillite, blue-gray, slightly calcareous; calcite joint filling. Thin beds of red shale are in this interval | 180 — 190 |
| Argillite, blue-gray, moderately calcareous; calcite and quartz joint filling. About 4 feet of this interval is red shale | 190 — 200 |
| Sandstone, gray, very fine grained; calcite joint filling and pyrite | 200 — 210 |
| Argillite, blue-gray, moderately calcarous; calcite joint filling and pyrite | 210 — 230 |
| Argillite, blue-gray, slightly calcareous; pyrite and geothite | 230 — 260 |

## Table 7. Sample logs of wells in the Brunswick Formation—Continued

Well Mg-679—Continued

| | |
|---|---|
| Siltstone, blue-gray, slightly calcareous; pyrite | 260 — 270 |
| Argillite, blue-gray, moderately calcareous; pyrite. Red shale, moderately calcareous; calcite joint filling and pyrite | 270 — 278 |
| Argillite, blue-gray, moderately calcareous; pyrite | 278 — 285 |
| Shale, reddish-brown, moderately calcareous; About 4 feet of this interval is blue-gray, moderately calcarous argillite | 285 — 308 |

Well Mg-700

Owner: Stanley G. Flagg, Inc.

| Description | Depth (feet) |
|---|---|
| Fill | 0 — 20 |
| Sandstone, buff, fine grained. About half of this interval is red shale | 20 — 30 |
| Shale, red, micaceous | 30 — 60 |
| Shale, red | 60 — 90 |
| Shale, red, slightly calcareous; quartz joint filling | 90 — 100 |
| Shale, red, slightly calcareous | 100 — 130 |
| Shale, dark brown, slightly calcareous | 130 — 140 |
| Shale, red, slightly calcareous | 140 — 150 |
| Shale, red, moderately calcareous | 150 — 160 |
| Shale, red; calcite joint filling | 160 — 170 |
| Shale, red, slightly calcareous | 170 — 190 |
| Shale, red, moderately calcareous | 190 — 200 |
| Shale, red, moderately calcareous, micaceous; calcite joint filling | 200 — 250 |
| Shale, red, micaceous; calcite joint filling | 250 — 260 |
| Shale, red, slightly calcareous; calcite joint filling | 260 — 280 |
| Shale, gray-brown, slightly calcareous; micaceous; calcite joint filling | 280 — 290 |
| Shale, red, slightly calcareous; calcite joint filling | 290 — 330 |
| Siltstone, red, slightly calcareous; calcite joint filling | 330 — 340 |
| Shale, red, moderately calcareous | 340 — 350 |
| Shale, red, moderately calcareous; calcite joint filling | 350 — 360 |
| Siltstone, red, moderately calcareous; calcite joint filling | 360 — 370 |
| Shale, red, moderately calcareous; calcite joint filling | 370 — 390 |
| Shale, red, moderately calcareous; calcite and quartz joint filling | 390 — 400 |
| Shale, red, moderately calcareous; calcite joint filling | 400 — 456 |
| Sandstone, white, fine grained | 456 — 461 |
| Shale, red, moderately calcareous; calcite joint filling | 461 — 480 |
| Argillite, blue-gray, moderately calcareous, interbedded with about 3 feet of buff sandstone | 480 — 500 |
| Sandstone, light-brown, fine grained | 500 — 510 |
| Sandstone, light-brown, medium grained | 510 — 520 |
| Shale, brown, slightly calcareous, micaceous; calcite joint filling | 520 — 530 |
| Shale, brown, slightly calcareous, micaceous; quartz joint filling | 530 — 540 |
| Shale, red, moderately calcareous; calcite joint filling | 540 — 560 |
| Shale, red, moderately calcareous; calcite and quartz joint filling | 560 — 600 |
| Shale, red, slightly calcareous; calcite joint filling | 600 — 610 |
| Shale, red, moderately calcareous; calcite joint filling. About 1 foot of this interval is buff, fine grained sandstone | 610 — 620 |
| Shale, red, moderately calcareous; calcite joint filling | 620 — 640 |

## Table 7. Sample logs of wells in the Brunswick Formation—Continued

Well Mg-704

Owner: Lansdale Municipal Authority

| Description | Depth (feet) |
|---|---|
| Shale, red | 0 — 10 |
| Shale, red, slightly calcareous; calcite joint filling | 10 — 20 |
| Shale, red | 20 — 40 |
| Shale, red, slightly calcareous | 40 — 50 |
| Shale, red, slightly calcareous; calcite joint filling | 50 — 70 |
| Shale, red, moderately calcareous; calcite joint filling | 70 — 80 |
| Shale, red, slightly calcareous; calcite joint filling | 80 — 140 |
| Shale, red, moderately calcareous; calcite joint filling | 140 — 190 |
| Shale, red, slightly calcareous; calcite joint filling | 190 — 200 |
| Shale, red, slightly calcareous; calcite joint filling and pyrite | 200 — 210 |
| Shale, red, slightly calcareous; calcite joint filling | 210 — 220 |
| Siltstone, red, slightly calcareous; goethite | 220 — 230 |
| Argillite, blue-gray to greenish-gray, slightly calcareous; calcite joint filling and goethite | 230 — 240 |
| Shale, gray-brown, slightly calcareous; calcite joint filling and goethite | 240 — 250 |
| Shale, red, moderately calcareous; calcite joint filling and goethite | 250 — 260 |
| Shale, red, moderately calcareous; calcite joint filling | 260 — 290 |
| Shale, red, slightly calcareous; calcite joint filling, pyrite and goethite | 290 — 310 |
| Shale, red, slightly calcareous; calcite joint filling | 310 — 330 |
| Argillite, blue-gray, moderately calcareous; calcite joint filling and pyrite | 330 — 360 |
| Argillite, blue-gray, moderately calcareous; calcite joint filling and goethite | 360 — 370 |

Well Mg-725

Owner: Schwenksville Water Co.

| Description | Depth (feet) |
|---|---|
| Shale, red, slightly calcareous; calcite joint filling | 0 — 20 |
| Shale, red, slightly calcareous; quartz joint filling, pyrite and goethite | 20 — 30 |
| Shale, red, moderately calcareous; calcite joint filling, pyrite and goethite | 30 — 40 |
| Shale, red, slightly calcareous; joint filling | 40 — 50 |
| Shale, red, a few green spots, moderately calcareous | 50 — 60 |
| Shale, red, moderately calcareous. About 4 feet of this interval is purplish-brown | 60 — 70 |
| Shale, red, slightly calcareous; calcite joint filling | 70 — 80 |
| Shale, red, moderately calcareous; calcite and quartz joint filling | 80 — 90 |
| Shale, red, slightly calcareous; quartz joint filling | 90 — 100 |
| Shale, red, moderately calcareous; calcite joint filling | 100 — 110 |
| Shale, red, slightly calcareous; calcite and quartz joint filling | 110 — 120 |
| Shale, red, slightly calcareous; calcite joint filling | 120 — 150 |
| Shale, red, slightly calcareous | 150 — 160 |
| Shale, red, slightly calcareous; calcite joint filling | 160 — 180 |

**Table 7. Sample logs of wells in the Brunswick Formation—Continued**

Well Mg-725—Continued

| | |
|---|---|
| Shale, red, slightly calcareous; calcite and quartz joint filling | 180 — 190 |
| Shale, red, slightly calcareous; calcite joint filling | 190 — 200 |
| Shale, red, moderately calcareous; calcite and quartz joint filling | 200 — 210 |
| Shale, red, moderately calcareous; calcite joint filling | 210 — 220 |
| Shale, red, slightly calcareous; calcite joint filling | 220 — 240 |
| Shale, red; calcite joint filling | 240 — 250 |
| Shale, red, slightly calcareous; calcite joint filling | 250 — 290 |

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS
GENEVIEVE BLATT, SECRETARY

TOPOGRAPHIC AND GEOLOGIC SURVEY
ARTHUR A. SOCOLOW, STATE GEOLOGIST

Base map from U. S. Geological Survey 7½-minute topographic maps, 1947-1957

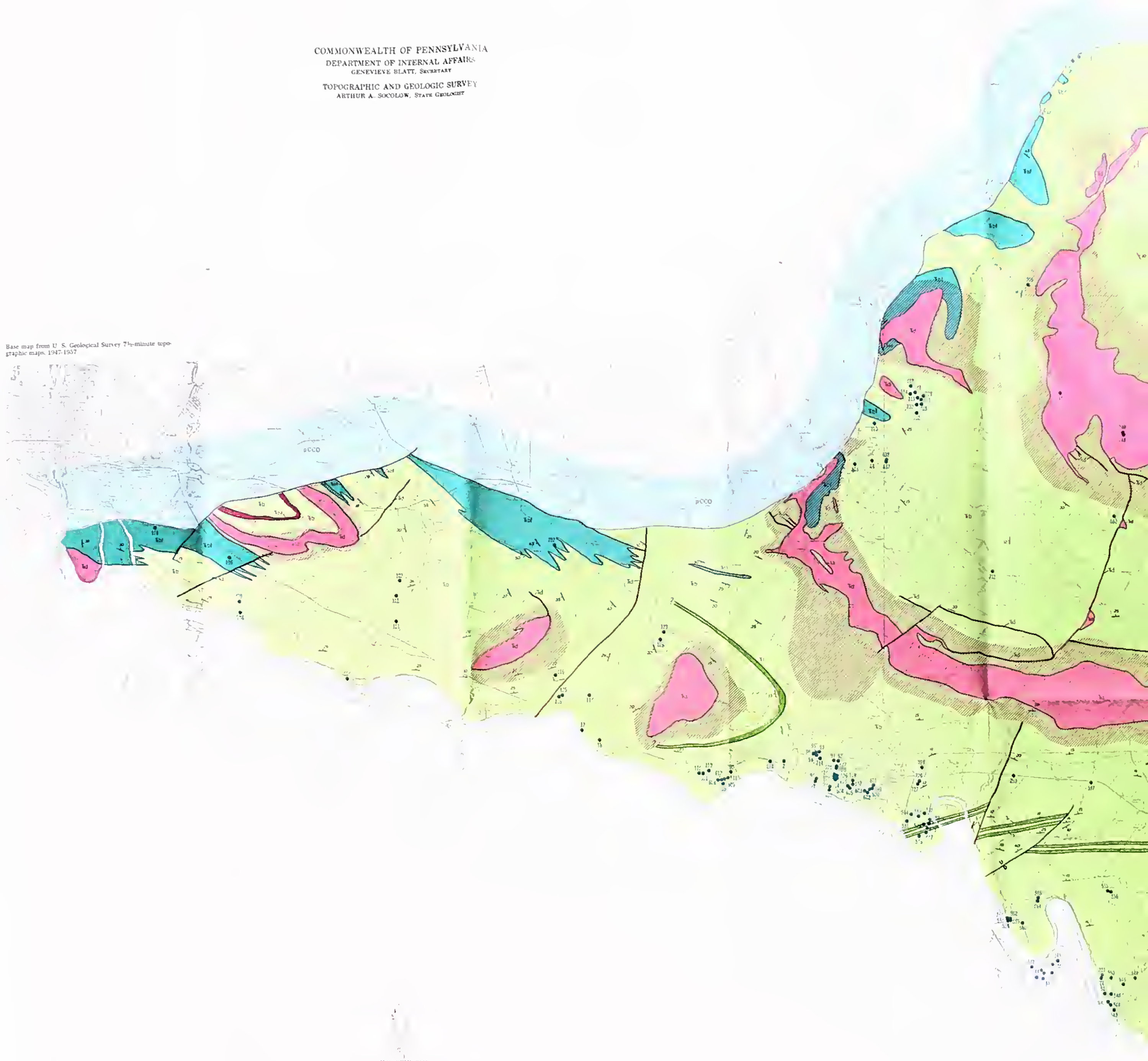
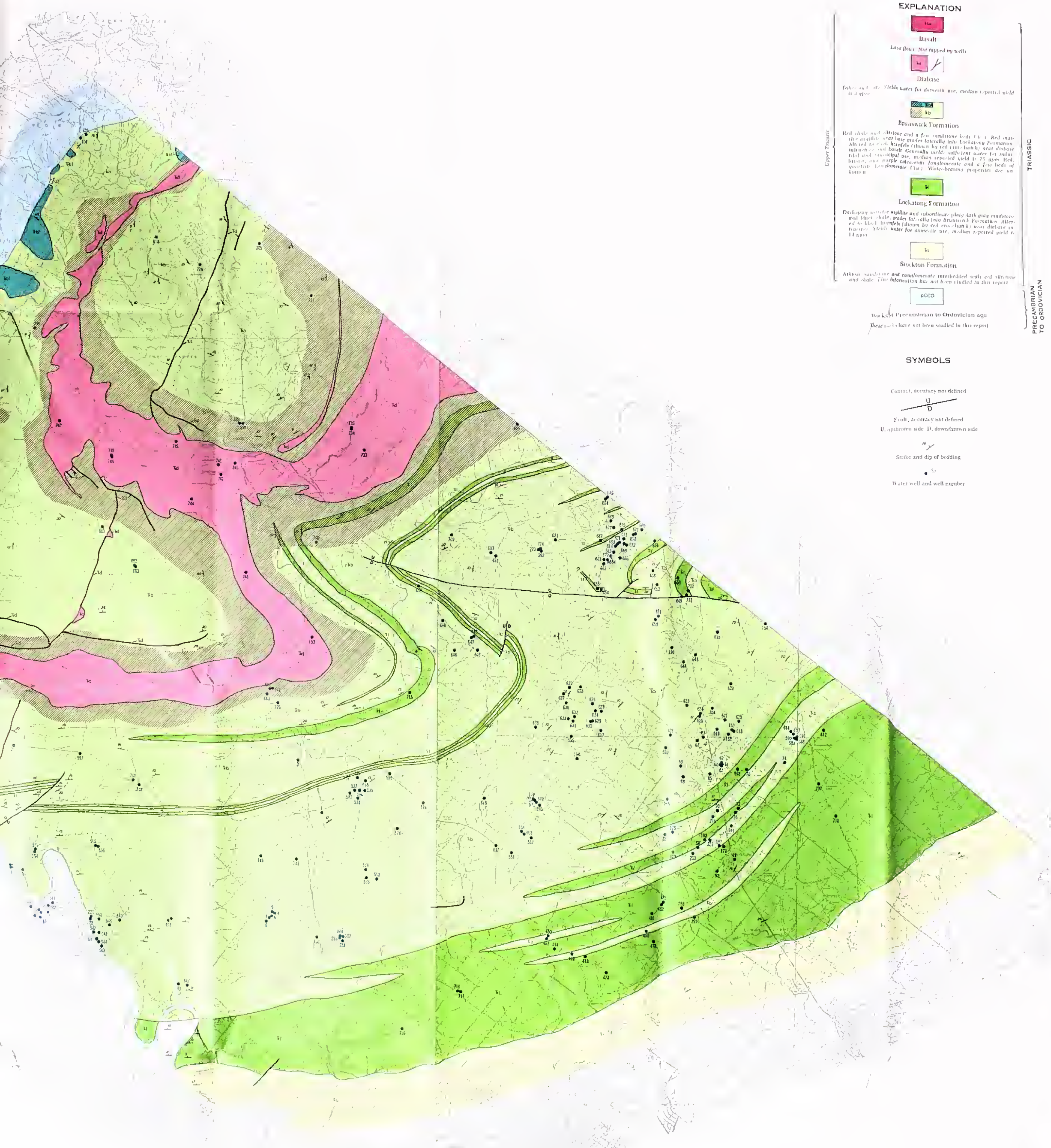


PLATE 1. GEOLOGIC MAP OF THE BRUNSWICK AND LOCKATONG FORMATIONS IN BERKS AND MONTGOMERY COUNTIES, PENNSYLVANIA, SHOWING WELL LOCATIONS.



## EXPLANATION

TRIASSIC

Upper Triassic

**Basalt**

Lava flows. Not tapped by wells

**Diabase**

Dikes and sills. Yields water for domestic use, median reported yield is 3 gpm

**Brunswick Formation**

Red shale and siltstone and a few sandstone beds (Trb). Red massive argillite near base grades laterally into Lockatong Formation. Altered to dark hornfels (shown by red cross-hatch) near diabase intrusives and basalt. Generally yields sufficient water for industrial and municipal use, median reported yield is 75 gpm. Red, brown, and purple calcareous fanglomerate and a few beds of quartzite fanglomerate (Trbf). Water-bearing properties are unknown

**Lockatong Formation**

Dark-gray massive argillite and subordinate platy dark gray mudstone and black shale, grades laterally into Brunswick Formation. Altered to black hornfels (shown by red cross-hatch) near diabase intrusives. Yields water for domestic use, median reported yield is 11 gpm

**Stockton Formation**

Arkosic sandstone and conglomerate interbedded with red siltstone and shale. This information has not been studied in this report

PRECAMBRIAN TO ORDOVICIAN

pCCO

Rocks of Precambrian to Ordovician age

These rocks have not been studied in this report

## SYMBOLS

Contact, accuracy not defined

U
D

Fault, accuracy not defined
U, upthrown side D, downthrown side

Strike and dip of bedding

Water well and well number

Geology by D. B. McLaughlin, E. T. Wherry, G. W. Stose, A. I. Jonas, E. F. Bliss, Florence Bascom, T. V. Buckwalter, Harold Meisler, and others. Compiled and revised by C. R. Wood, 1963.